SCIENTIFIC AMERICAN

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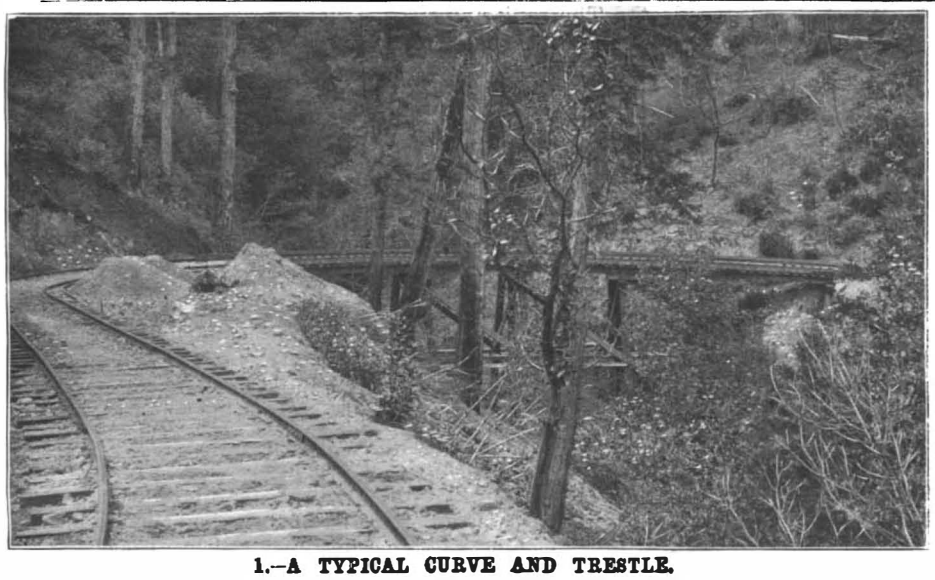

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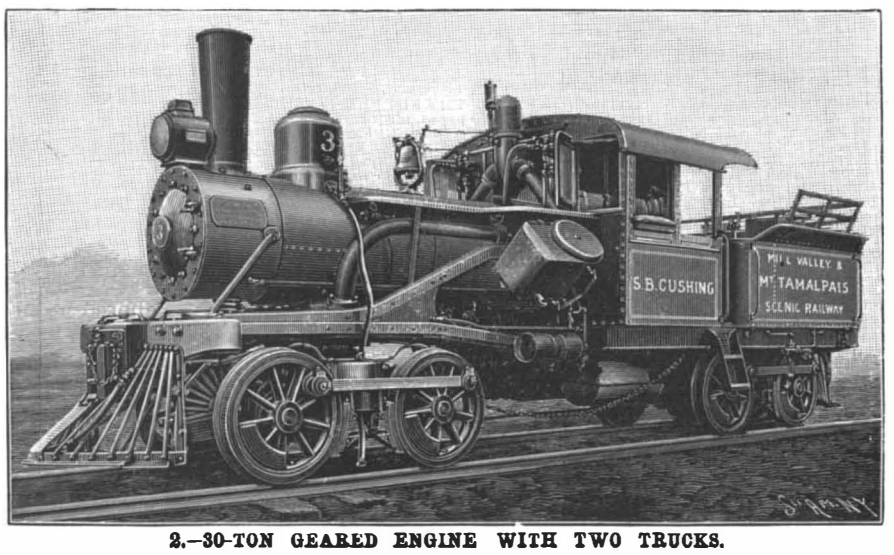

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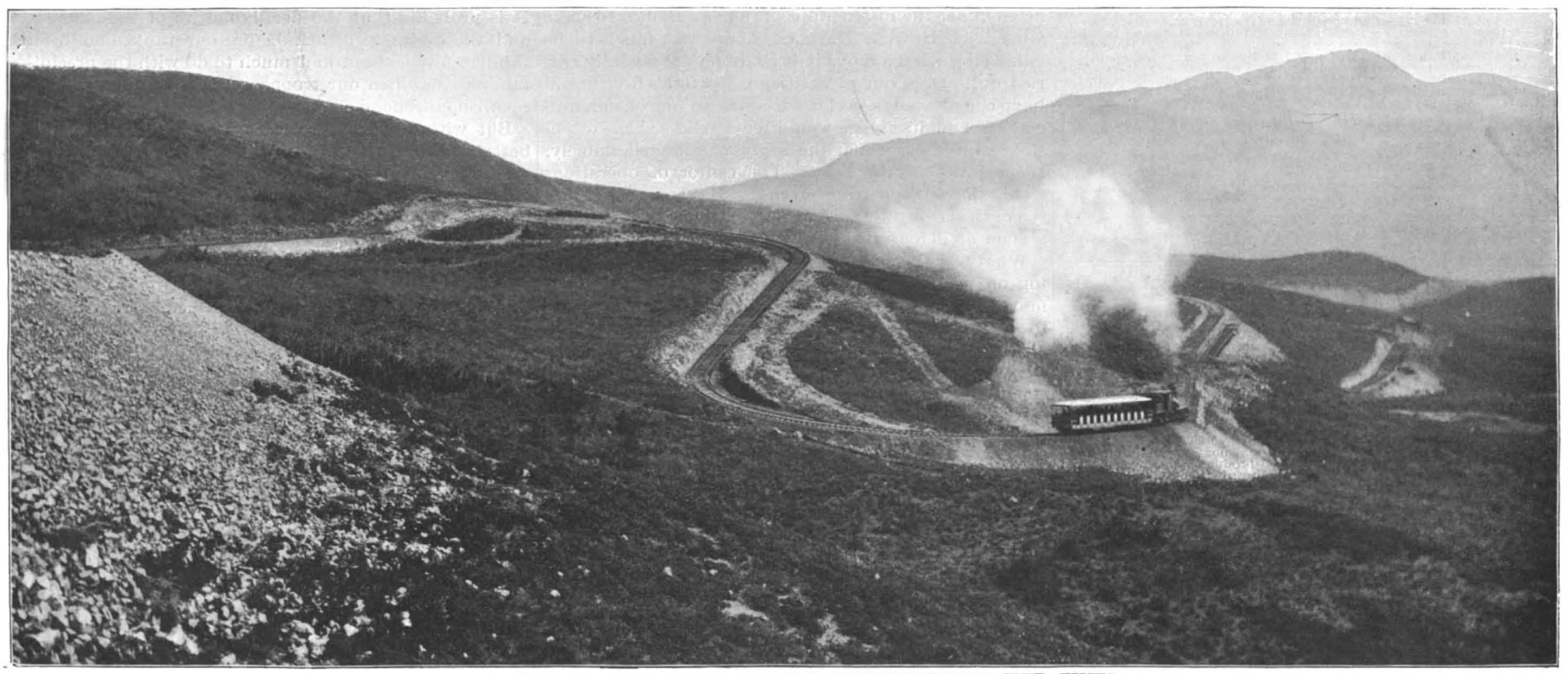

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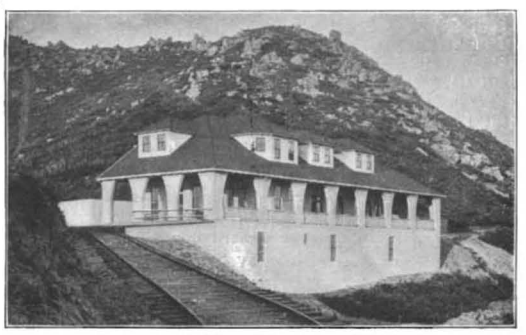

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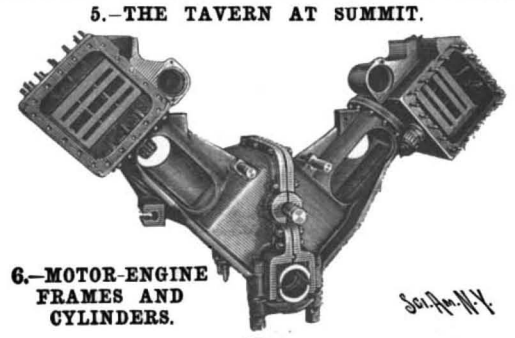

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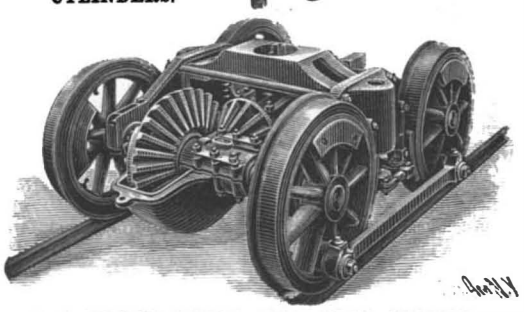

7.—A TRUCK WITH GEAR-CASE OPENED.

GEARED LOCOMOTIVES ON THE MOUNT TAMALPAIS SCENIC RAILWAY.—[See page 39.]

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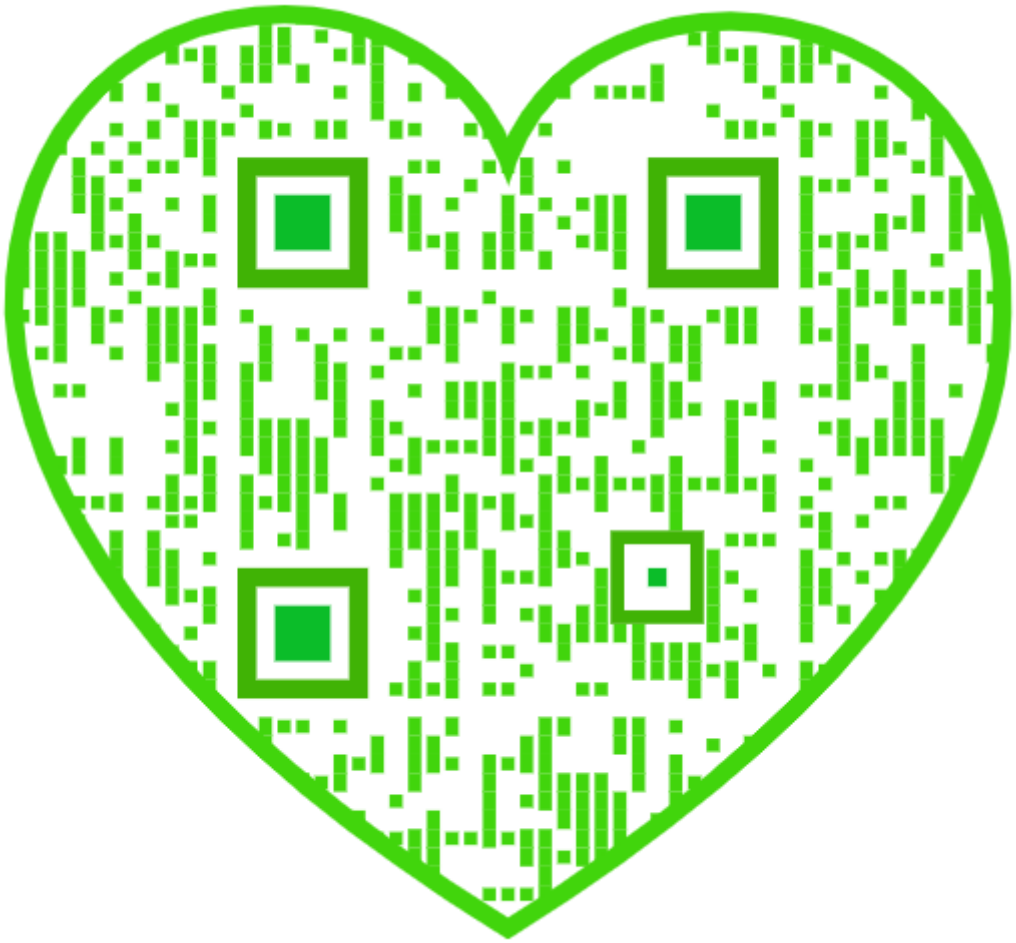

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THE DESTRUCTION OF CERVERA'S FLEET.

Before the opening of the present war the world was asking whether the destructiveness of our weapons of naval warfare was as great as theoretically it could be proved to be. The question has already been answered in two hemispheres. At Manila a fleet of nine cruisers, fighting beneath the shelter of friendly fortifications, was annihilated in the course of a single morning; at Santiago de Cuba as fine a squadron as ever sailed the seas, comprising four swift armored cruisers and two of the largest and most powerful torpedo boat destroyers in the world, was wiped out of existence in less than sixty minutes.

It is remarkable that in both cases the beaten fleet was overwhelmed by the same element of a ship's offensive powers—the gun. In neither case was there any call for the services of the ram or the torpedo.

The war between China and Japan gave us an inkling of the importance of the gun in modern naval warfare. Manila and Santiago have established it as par excellence the deciding factor (always supposing, of course, that it is well handled) of the sea fight of the future. Had it not been for the accuracy, heavy caliber and great carrying power of our guns, the speedy ships of Admiral Cervera's fleet would now be anchored in Havana Harbor, and our whole plan of campaign, both naval and military, would have been upset. As it is, thanks to the splendid marksmanship of our men, we were able to "wing" the flying cruisers, close in with them, and complete their inevitable destruction.

Just why Cervera elected to run the gauntlet of our fleet is a matter of speculation. Either he foresaw the speedy fall of Santiago and feared to be caught between the guns of army and navy, or, as is reported, he acted under the instructions of General Blanco to make a dash for Havana Harbor. There was much to be gained by such a move if it could be successfully carried out. Once out of Santiago, Cervera's fleet would have constituted a serious menace to our communications, and its escape would have removed the ostensible object for which the army was landed, namely, the capture of the fleet. The center of operations would have been transferred to Havana, where the strength of the Spanish army is gathered, and the system of defense is by this time enormously strong.

Whatever the cause, the fact remains that, after taking on as full supplies as were obtainable, the fleet moved at full speed out of the harbor, and attempted to break through the blockading fleet by steaming along the coast to the westward. Its chances of escape were good, all things considered. The four cruisers, "Christobal Colon," "Teresa," "Oquendo," and "Viscaya," were all of 20 knots speed, the last, indeed, having made 21 knots on her trial, and the destroyers, "Furor" and "Pluton," were supposed to be good for 28 and 30 knots. Against them were the "Iowa," 17·1 knots; "Oregon," 16·8 knots; "Texas," 17·8 knots; and the "Brooklyn," 21·9 knots, together with a couple of converted yachts of 16 or 17 knots speed. Our ships were lying some 2½ miles from the entrance, and, as the Spanish ships turned sharply to the west and hugged the coast, their escape from all but the "Brooklyn" was assured, unless they could be brought down by some well-placed shells. Moreover, judged by the canons of modern warfare, the possession by the Spaniards of powerful and numerous rapid-fire batteries gave them a decided advantage in a running fight, for, by concentrating their fire on the unarmored ends of our ships, they should have been able to retard their speed to such an extent as to make their own escape certain.

They came out of the harbor with every gun shotted and opened a heavy fire as they steamed past, the attack being concentrated on the "Iowa," as being the most formidable ship of the fleet. The plan of battle was to disable the "Iowa" and draw after them the swifter "Brooklyn," hoping to close in and cripple her when they had drawn away beyond range of the heavy guns of the battleships.

The plan, so far as the ships were concerned, was feasible. Had the conditions been reversed, and the Spanish fleet been in American hands and vice versa, it would undoubtedly have been successful. As it was, American gunnery won the day, and won it in very short order. In less than twenty five minutes from the moment that the bow of the "Christobal Colon" first showed at the mouth of the harbor two of the Spanish ships had been driven on the beach; in less than three-quarters of an hour another had surrendered, and in fifty-six minutes, according to one of the officers on the "Iowa," the whole fleet of six ships had been driven in a sinking condition upon the coast.

The Santiago fight has served to blast the reputation of the torpedo boat destroyer, which had already been shaken by the repulse of the "Terror" a few days before at San Juan by the ocean liner "St. Paul." The converted yacht "Corsair," now the "Gloucester," engaged these two vessels with such success that one of them, at least, appears to have been sunk by her fire. It is true the destroyers were designed for attacking torpedo boats, and their opportunities for offensive operations against larger craft are supposed to be confined to foggy weather and dark nights. Yet we cannot but feel that with their great speed something might have been done, even on this bright Sunday morning. As it is they have proved the easiest kind of prey for ships which have only recently and hastily been converted from uses of pleasure and commerce to those of war.

We spoke last week of the undying value of the personal equation in modern warfare. Santiago adds its eloquent testimony to the truth that to-day, as of old, it is the "man behind the gun" that wins the fight.

OUR ARMY AT SANTIAGO.

The rank and file of the American army has again demonstrated its ability to fight its way to success through and in spite of difficulties that might well have dismayed a veteran army. In estimating the work done by our men in the fighting of Friday and Saturday, July 1 and 2, we must remember that they were not only attacking seasoned troops entrenched in strongly fortified positions, but the attack was made under a tropical sun and in a climate which is known to be one of the most trying in the world. The difficult nature of the country prevented the bringing up of supplies fast enough to provide the troops with full rations, and the execrable condition of the roads rendered it impossible to bring to the front sufficient artillery to cover the advance of our attacking columns.

In view of the frightful cost in killed and wounded at which the heights were stormed and taken, much of it due to the shrapnel which was used with deadly effect by the Spanish artillery, it will be asked why the attack was not deferred until we had time to bring up an adequate number of guns to silence the enemy's batteries and properly cover the advance of our men. It is probable that the deadly nature of the climate, and the desire to attack before our ranks had been thinned by sickness, had much to do with the precipitancy with which our troops were rushed against the Spanish entrenchments.

But without entering into criticisms which must at best be based upon partial information, the country may feel a just pride in the splendid fighting qualities displayed alike by our regular and volunteer regiments. The taking of El Caney and the storming of San Juan heights have shown that the combined dash and steadiness which were conspicuous on both sides in the great Civil War may still be counted on to win the country's battles when we are called on reluctantly to take up the sword.

It was a soldier's fight, in which the gallant leadership of the officers met a noble response from the men; and the heroism of those two days is witnessed by the endless stream of dead and wounded that moved slowly to the rear during the long hours of that memorable struggle.

THE LOSS OF THE "BOURGOGNE."

Our readers are already familiar with the harrowing details of the loss of the "Bourgogne," with 560 lives, in the North Atlantic. We have no intention of entering into a discussion of her general features of the disaster further than to observe that, as contrasted with the detestable cowardice and villainy of the crew, it is a mournful gratification to know that the officers did their duty to the last and to a man perished with the ship.

The awful suddenness with which the ship went down as the result of the complete failure of her watertight compartments will shake the confidence of the public, already rudely strained, in the system of watertight bulkheads as a means of keeping an injured vessel afloat. The "Oregon," the "Elbe," and now the "Bourgogne" testify that, however perfect it may be in theory, the subdivision of a modern liner is not a sure guarantee against foundering.

We wish to draw attention to one feature of the wreck which is very suggestive, and indicates that there is a faulty element in the arrangement of the bulkheads which may have been answerable for their failure to keep the vessel afloat. We refer to the fact that the ship commenced to heel heavily from the moment she was struck, and that the decks before she went down were inclined at an angle of 45°. This heel was due to the fact that the longitudinal bulkhead which divides a ship from stem to stern into two equal halves prevented the inrushing water from passing clear across the vessel, and threw her out of trim. As the heel increased, the water must have risen above the lower and possibly the upper row of gangways and portholes, and finding its way in through these it must have hastened the end.

It was the longitudinal bulkhead that caused the British battleship "Victoria" to capsize after she was accidentally rammed by the "Camperdown." Had the water been free to flow clear across the vessel, she might have sunk until her bow was almost awash, but it is probable that she would have kept afloat long enough to be towed into harbor or run ashore. As it was, the starboard compartments being filled, while those to port were empty, the ship was thrown over to starboard until the water, rushing in through the gunports, completed the capsize.

It is a question well worth considering whether th

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safety of a vessel would not be better secured by making the transverse bulkheads more numerous and dispensing with the longitudinal bulkhead except as a division between the engine rooms. In this case, if a couple of compartments were filled by the smashing of a bulkhead in collision, the ship would be filled clear across from side to side, and she would merely settle low in the water, without any dangerous list to one side or the other.

The question is well worth the careful consideration of our marine architects and builders.

OUR FOREIGN COMMERCE.

The most remarkable eleven months in the history of American commerce is graphically told in the last summary prepared by the Bureau of Statistics, which has appeared a month earlier than is usual with these tabulations. Ordinarily this pamphlet is rather dull reading to all who are not in any way interested in finance or commerce, but the present issue contains remarkable figures, which are startling to all who have not closely watched the fiscal year which has just drawn to a close. These figures show in brief that our exports more than doubled the imports, and more manufactured goods are exported than are imported, and more gold has been brought into the country than in any preceding year.

An analysis of the tables is interesting, especially in view of the fact that for many months we have had the menace of war hanging over our heads, and some of the time actual warfare, which usually tends to decrease export trade; but this has not been the case in the period we are considering.

During the eleven months ending with the last day of May, 1898, our imports of free and dutiable merchandise amounted to $563,770,032, against $679,547,391 for the corresponding period of 1897. This is offset by the export of domestic goods to the amount of $1,117,284,973 in 1898, against $960,120,120 in 1897. In other words, foreign countries owe us $553,501,941 for the value of goods which they received from us in addition to the goods which they have sold us for our consumption, or $280,572,729 increase in a year.

The ratio of imports to exports is best told by the annexed tables:

IMPORTS INTO THE UNITED STATES.

	Value.	Per cent.
Articles of food and live animals	$164,666,161	29·42
" in a crude condition	186,852,835	33·14
" manufactured for the mechanic arts	64,190,123	11·39
" " for consumption	75,930,142	13·47
Luxuries, etc	72,130,771	12·58
	$563,770,032	100·00

EXPORTS FROM THE UNITED STATES.

	Value.	Per cent.
Products of agriculture	$795,114,328	71·17
" " manufactures	261,655,784	23·42
" " mining	17,831,022	1·59
" " forest	34,049,528	3·05
" " fisheries	5,203,499	0·46
" " miscellaneous	3,430,812	0·31
	$1,117,284,973	100·00

The greatest reduction in the imports considered by classes was in manufactured articles ready for consumption, which fell off from $117,352,182 in the eleven months of 1897 to $75,930,142 in the same period in 1898. For the first time American exports of manufactured articles are exceeding imports, which is of deep significance, owing to the special facilities for manufacturing which Europe affords because of the cheapness of labor and the utilization of water power, cheapfuel, etc.

Of the $563,770,032 worth of articles imported into the United States, $267,448,136 came in duty free, or 47·44 per cent of the total imports. The duties collected on the $296,321,896 worth of goods which were subject to duty amounted to $135,263,865, a falling off of $19,492,376, a sum which we can readily spare when we think of the splendid balance of trade in our favor.

The tables are capable of more minute analysis, but this would probably be fatiguing to the average reader, and the 1878 pages in the annual volume to date may well be left to the statistician; it is enough for the average reader to know and rejoice that in our year of trial over $550,000,000 has been or is to be paid to us, so that we are receiving nearly $2,000,000 for each working day, a truly magnificent sum to be charged up on the credit side of the ledger.

THE HOSPITAL SHIP "RELIEF."

The War Department has had this vessel fitted up in the most approved style for the comfort of the sick and wounded soldiers in the army. The ship is divided into five large wards and contains besides store rooms, mess rooms, operating rooms and officers' quarters. There is also a complete equipment of every appliance known to modern medical or surgical science including, among other things, two complete X-ray outfits, a microscopic laboratory, perfect facilities for photographing, and electrical apparatus of various kinds. Electrical fans everywhere abound to fan the sick.

The wards are models in their way. The walls are painted white, the floors covered with rubber tiling, and the beds of iron, enameled white.

Baths abound; they are connected with all the wards, with all the private quarters of the medical staff and with those of the ship's officers. There is a special shower bath for sick officers, and it is so arranged that the shower throws hot or cold, fresh or salt water. All the bath rooms have rubber floors.

The ship sailed recently for Santiago de Cuba, where it will be most useful and acceptable to our soldiers injured in the battles about that place.

It is probable this will be the first extended use of the X-ray apparatus in war, and reports of its success will be watched with interest.

"THE ENGINEER'S" ANALYSIS OF AMERICAN AND SPANISH WARSHIPS.

In our issue of May 7 we replied to an article in The Engineer, which compared the Spanish and American navies in respect of the speed and batteries of their fighting line. It will be remembered that The Engineer gave figures to prove that the Spanish line of battle was superior in every respect but that of total displacement. Its energy of fire per minute was estimated at 1,529,516 foot-tons, as against 1,120,323 foot-tons for our own, and its average speed 23·67 knots, as against 19·63 knots for our ships. In our reply we showed that, if the same types of ships as The Engineer had selected in making up the Spanish line were included in the American line, the table would be reversed. By offsetting our protected "Cincinnati" and "Marblehead" class against the Spanish protected "Alphonso XIII." and "Lepanto" and including the monitors (The Engineer included the Spanish but omitted the American protected cruisers, ignored the monitors altogether and forgot to mention the "Oregon" and "Texas"), we showed that the energy of fire of our line would be raised from 1,120,323 foot-tons to 2,820,883, and that on every point save that of speed we possessed a considerable superiority.

Since these articles were penned, the naval engagements of Manila and Santiago have been fought. A dozen sunken hulks in Cavité Bay and half a dozen more strewn along the southern coast of Cuba are the Spanish fruits of a struggle out of which our ships have come at the cost of one man killed, scarce a dozen wounded, and not a ship even temporarily disabled.

The Engineer made a strong point of the fact that our fighting line was practically devoid of rapid-fire guns, and in our reply we showed that not only were forty-two of these weapons carried on the ships enumerated in its tables, but that the protected cruisers, which should have been included, carried forty of these weapons, making eighty-two in all.

In reply to our criticism, The Engineer has published in its issue of June 10 an exhaustive comparison of our own battleships and armored cruisers with those of the leading naval powers in respect of the energy of their heavy rapid-fire armament. Our contemporary admits the truth of our corrections, except as regards the rapid-fire armament of our battleships, and to substantiate its position enters into a careful review of the present status of our own and other battleships and armored cruisers in this respect. Inasmuch as The Engineer limits the discussion to battleships and armored cruisers only, the article which we reprint cannot be considered as an answer to our reply. We take it that, with Manila and Santiago in mind, The Engineer is now willing to admit that both on paper and in fact we have established the superiority of our fleet over that of the plucky but badly worsted Spaniards. We publish The Engineer's article in another column, both for its own intrinsic interest and for the reason that it draws attention to a fact which we as a nation shall do well to carefully take note of, namely, the enormous development of rapid-fire batteries in the later warships of the world.

While we do not attempt to deny and have, indeed, always deplored the fact that our battleships, as distinct from our cruisers, are weak in rapid-fire energy, it is but fair to point out that the "Indiana," "Massachusetts," and "Oregon" were authorized as far back as 1890, or previous to the period in which, as The Engineer shows, the rapid-fire gun was introduced. The special, we had almost said the sensational, feature in these ships is the battery of eight 8-inch guns with which they are equipped. The guns are carried behind 6 inches of Harveyized steel, at an altitude of 26 feet above the water line, and even the most ardent advocate of the rapid-fire gun must admit that these 40-caliber guns, with their armor-piercing capacity, high command, great carrying power, and good protection, are a fair offset against the unprotected rapid-firers of other navies.

This, at least, is the lesson taught by the brief 55-minute engagement off Santiago. The 6 and 5·5-inch rapid-fire batteries of the four armored Spanish cruisers should have made our gun-positions untenable, yet all the damage done to our fleet in that artillery duel of 55 minutes was a few shot holes and one man killed. Meanwhile our 12 and 8-inch guns were crashing through 12-inch armor belts, crippling engines and boilers, and driving the Spaniards to beach their ships in the endeavor to escape foundering in deep water. Verily the armor-piercing gun has received its vindication, and another argument is placed in the mouths of those naval men (and they are not a few) who deplore the passing of the 8-inch gun and its substitution by the 6-inch rapid-firer.

We can anticipate the reply which will be made by our contemporary, to the effect that the full potentiality of a gun can only be realized when there is a marksman behind it. We know that the Spaniard has the reputation of being a notoriously bad gunner, and that in this conflict the value of the technical lessons to be learned is greatly lessened by the woful inaccuracy of Spanish marksmanship. At the same time, after making due allowances, the naked fact remains that the Spanish ships, with their rapid fire batteries, are strewn along the Cuban coast, while the ships that were weak in this type of weapon have scarcely a scratch to show for the conflict.

There is fashion even in such an unsentimental matter as warship design, and it is the fashion just now to develop the rapid-fire gun to a point at which it is the chief element of offense in the ship. Our new battleships will be conspicuous examples of this tendency, and their broadside batteries of fourteen 6-inch rapid-firers will place them in the very front rank among modern warships.

At the same time there is every reason why the four 6-inch slow-firers on the "Indiana" and her type should be replaced with rapid-fire weapons. Their offensive power would be quadrupled by the change. Moreover, we hope that one of the first changes to be made at the close of the present war will be the substitution, in every case, of rapid-fire weapons for the slow-firers, which are still to be found on some of the crack cruisers of our navy. The change was urgently recommended by Ex-Assistant Secretary of the Navy Roosevelt, and has been carried out on ships like the "Chicago," which are now undergoing refitting at our navy yards. When a similar change has been made on the "Baltimore," "San Francisco," and others of their class, the fighting efficiency of these ships will be increased fully fifty per cent.

Limitations of space forbid our discussing this very live question at further length in the present issue, but we hope in an early issue to take up the matter at fuller length and show the exact status of our ships in respect of rapid-fire armament.

On the question of "feeding" the guns, concerning which our contemporary asks for enlightenment, we follow its excellent rule of withholding information on such an important question until the international sky is less overcast. When the present war is over, we shall be prepared to say more upon this question.

The Floating Machine Shop "Vulcan."

The floating machine shop of the United States navy has been named the "Vulcan," and this vessel is now with Admiral Sampson's fleet and was ready to repair any damage which might have been sustained at the hands of Admiral Cervera; but it is likely that now she will devote her attention to saving some of the wrecked vessels in conjunction with the wrecking companies. It is said that $300,000 was spent in altering and equipping this vessel. Officially the "Vulcan" is an engineers' repair ship, and formerly she was the steamer "Chatham." Shortly before the war, Engineer in Chief Melville recommended that two vessels be purchased which could be transformed into engineers' repair ships and attached to the Atlantic and Flying squadrons. Only one steamer was purchased by the Auxiliary Board, and she was transformed at the Boston navy yard. While the ship is not intended for fighting purposes, she carries two rapid-fire 6-pounder guns. The "Vulcan" is to follow in the wake of the fleet, and she has a large coal capacity which will give a wide radius of action. She will also supply fresh water to other vessels and make such repairs as may become necessary. The bow of the boat is devoted to a stock room; back of this is the blacksmith shop, foundry, and machine shop. There are also evaporators and distillers of a capacity equal to a daily output of 10,000 gallons of water. There is a complete foundry with a cupola, which will enable castings to be made on the boat. She has two steam cranes with 10-foot arms, which are especially designed for moving weights from a man-of-war and for transferring machinery to a disabled ship. There are also plate-bending rolls, punches, shears, lathes, planers, drills, milling machines and other machine tools, which will enable them to repair the hulls, engines, and boilers or guns. The "Vulcan" carries a large complement of first-class mechanics, and the repair shop has some of the finest engineers in the country. It is doubtful if any vessel has yet started out to war which has carried such a large complement of well-trained and well-educated men. The "Vulcan's" captain is Lieut.-Commander Ira Harris, who has been general manager of the Chicago Drop Forge and Foundry Company. The chief engineers are Gardiner Sims, the head of the Armington-Sims Engine Works, of Providence, Rhode Island, who has thirty of his best mechanics aboard, and Prof. Aldrich, of the University of Virginia, one of the best electrical experts in the country. Out of her entire crew of two hundred men, ninety-two have the right to wear the officer's cap.

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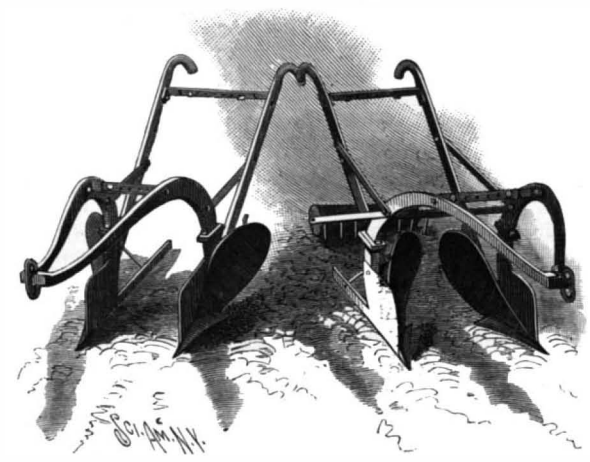
AN IMPROVED PLOW.

The plow which we illustrate herewith is so constructed as to throw earth simultaneously from both sides to a common center or line in covering cane or in the cultivation of plants. The plow may be also adjusted to throw the earth from a common center or line to opposite sides of the plants under cultivation. Our illustrations represent the plow in both adjustments.

The plow is constructed with two beams joined at their front ends and diverging as they extend rear-



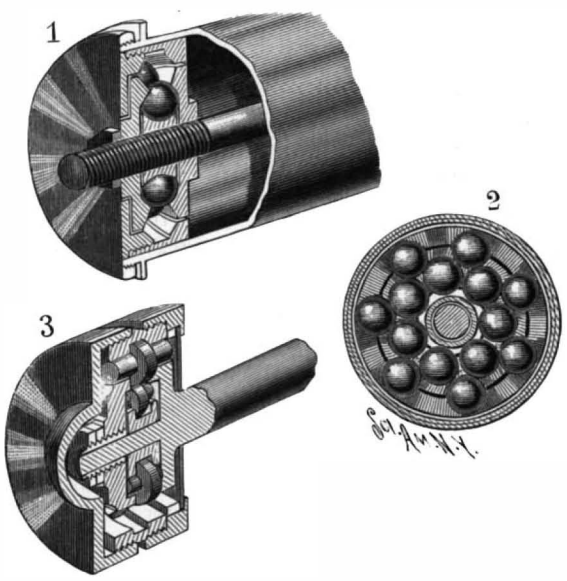
ROSS' IMPROVED PLOW.

wardly. These beams are adjustably connected near their rear ends by sliding bars. The mouldboards are somewhat longer than in ordinary plows, and are designed to throw the earth farther than usual. The landsides are also longer than in the plows now in use, rendering this plow steadier and easier to run. The handles of the plow are capable of being removably connected either with brackets attached to the mouldboards or with arms attached to the shanks. When the plow is adjusted to throw the earth inwardly, a roller and rake are attached to the beams, so that the earth thrown up by the plow may be cultivated by the rake and flattened by the roller. When it is desired to throw the earth outwardly, the plows are interchanged; that is, the plow which was on the right side is now attached to the left side, the other plow being also changed so that its landside shall be turned inwardly. The roller and rake, when the plow is in this position, are removed, since they are not required.

This implement is exceedingly simple, durable and economic, and its plows may be quickly and easily shifted to perform the work for which it is designed. The improvements have been patented by Jesse W. Ross, of New Orleans, La.

A NEW BALL-BEARING.

An invention has recently been patented by James E. Lawrence, of West Shefford, Quebec, Canada, which



LAWRENCE'S BALL-BEARING.

provides a simple adjustable bearing designed to run without oil at a high speed with a minimum of friction. As shown by our illustrations, the bearing may employ either balls or rollers.

Referring to Figs. 1 and 2, it is seen that the bearing comprises a shaft having an inner radial flange. At the outer reduced end of the shaft a disk is secured having a raceway coincident with a raceway on the flange. In the space left between the flange and disk a grooved annulus is situated free from the shaft. In the groove of this annulus balls roll which are engaged by an outer series of balls contained between the raceways of the flange and disk. A ring free from the shaft engages with its raceways the outer series of balls and assists in keeping the parts in position. A cap adjustable relatively to this latter ring is also provided with a raceway to engage the outer balls and in addition keeps out the dust and other foreign matter.

In Fig. 3 we have illustrated a modification which employs rollers. In this case the flange has a peripheral projection. A flanged disk is secured to the outer reduced portion of the shaft and has longitudinal adjustment thereon. In the space between the disk-flange and the peripheral projection first mentioned, a grooved annulus is placed free from the shaft. An inner and outer series of rollers are employed. The inner rollers consist of disks having trunnions on opposite sides bearing upon the annulus. The outer rollers consist of similar disks whose trunnions bear upon the flange and disk. An outer grooved bearing ring surrounds the outer rollers. A cap and confining ring screw upon the bearing ring and keep the parts in place.

These bearings, it is claimed, possess an advantage over other forms in so far as they are designed to run without oil, thus obviating the necessity of removing the mixture of oil and dust which accumulates in most bearings. Another advantage of the invention is the absence of sliding friction between the parts when moving in their respective circuits.

Wheat Production.

The statistician of the Department of Agriculture has issued a detailed statement of the world's wheat production in 1897. The United States heads the list with 530,149,000 bushels, followed by France with 251,298,000, Austria-Hungary with 133,370,000, and Germany with 107,000,000 bushels. All other continental European countries with their enormous population to support produce 600,000,000 bushels, and the United Kingdom only 54,527,000 bushels; Argentine, which is so often quoted as being such a great wheat-producing country, could furnish only 32,000,000 bushels. The totals for the world in the last seven years are as follows:

1897	2,214,030.000
1896	2,428.000,000
1895	2,546,000.000
1894	3,676,003,000
1893	2,563,000,000
1892	2,482,000.000
1891	2,432,000,000

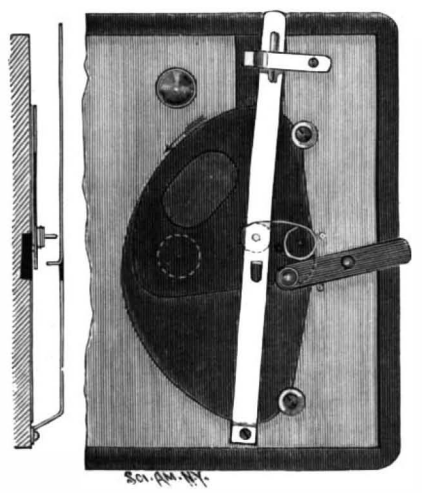
From the totals it will be seen that the United States furnishes nearly one-quarter of the total wheat produced in the entire world, so that it is little wonder that other nations regard with anxiety the war or anything else which tends to prevent the exportation of wheat and flour in accordance with the ordinary laws of supply and demand, and any raising of the price of the breadstuffs of America is sure to be a calamity to some countries where economic laws are quick to respond to any fluctuation in the price of this most important of commodities.

A SIMPLE MAGAZINE HAND CAMERA.

In the hand camera illustrated herewith will be seen one or two features of special interest which make it an extremely useful instrument for those about to begin the practice of photography.

We refer more particularly to the absence of complicated devices and the simplicity of the plate changing arrangement. In the larger engraving the plan of changing the plates or films held in suitable carriers is clearly shown. Under the lid of the camera, attached to a light-tight hinged metal frame, is a thin opaque double-lined rubber bag, having an opening which fits over the wrist, being secured thereto by an elastic band. The hand is slipped through the aperture, then the plates are changed by lifting the exposed plate upward and pushing it down behind to the rear of the bunch. There is the usual rear spring to keep plates pushed forward, so the front shall always occupy the focal plane. After a plate is changed, the flexible cloth is tucked inside and the lid closed, when the camera is ready for an exposure to be made. The plates are held in a metal sliding carrier, operated backward and forward by the focusing pinion in the interior on the shaft extending to the outside, where the varying focus for portraiture or views is readily obtained. On the front end is the usual finder, a shutter setting and releasing lever, as well as a button for regulating the speed of the shutter for time or instantaneous work, and another button for operating the diaphragm plate. The latter, showing the different apertures, may be seen in the small diagram engraving in the upper right hand corner, which also gives a general idea of the ingenious shutter mechanism. This consists mainly of two thin, sickle-shaped metal pivoted blades, connected by a link arranged to open and close when the button-releasing lever is pressed. Pressure downward on the upper lever sets the shutter, and for time exposure the movement is interrupted by a metal finger brought into position by the outside button. The two levers are connected by a spring, which is also the actuating spring. Attached to the right hand end of the connecting link is an ingenious toggle joint, which insures positive motion to the shutter. The latter is shown in an open position. Miniature springs also hold other parts in place.

In a less expensive camera having a fixed focus is another style of shutter shown in the small engraving. The dotted circle is the lens aperture. The shutter is fan-shaped, pivoted near the apex. Just in front of the pivot is the actuating pin, connected by a coiled spring to the end of the operating lever. The long upright lever has a section near the center cut out and bent down underneath, forming a stop or pin. When the lever is placed as shown and the operating lever on the side of the camera is pressed downward, the pin on the shutter (shown in dotted lines under the lever) strikes the stop on the under side and holds the shutter open for time exposure. By moving the upright lever to the left, the stop is taken out of the path of the pin on the shutter and the latter is free to move to the bottom, making an instantaneous exposure. Rub-



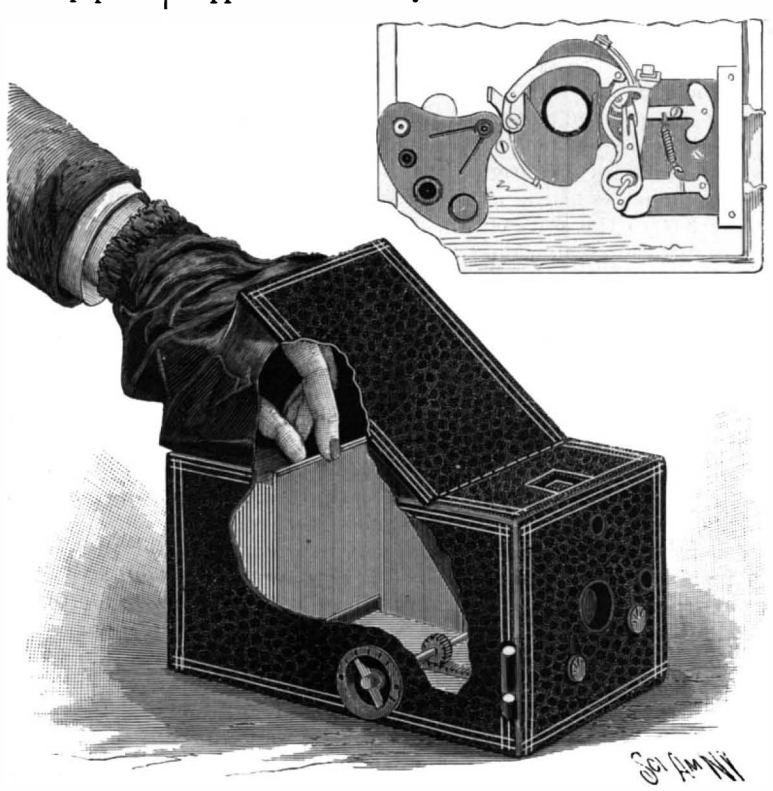
THE SHUTTER.

ber buttons at the top and bottom cushion the shutter at the end of each movement. The diagram at the side is a sectional elevation, showing clearly the position of the pin on the shutter.

The movements, it will be noticed, in the shutters of both cameras are simple and effective.

It is called the "Vive" camera and is made in Chicago, Ill., by the "Vive" Camera Company. The size of the picture is four inches square, and also four by five inches, and plates or films are used interchangeably as may be desired. It is a light, handy instrument, and judging from prints we have seen does excellent work.

THE vegetarians are making a great ado over the alleged triumph of their theory in the long-distance test of walking endurance, 70 miles, in Germany recently. The twenty-two starters included eight vegetarians. The distance had to be covered within 18 hours. The first six to arrive were vegetarians. The first finishing in 14¼ hours, the second in 14½ hours, the third in 15½, the fourth in 16, the fifth in 16½, and the sixth in 17½. The two last vegetarians missed their way and walked five miles more. All reached the goal in splendid condition. Not till one hour after the last vegetarian did the first meat-eater appear, completely exhausted. He was the only one. Others dropped off after thirty-five miles.



THE "VIVE" MAGAZINE CAMERA.

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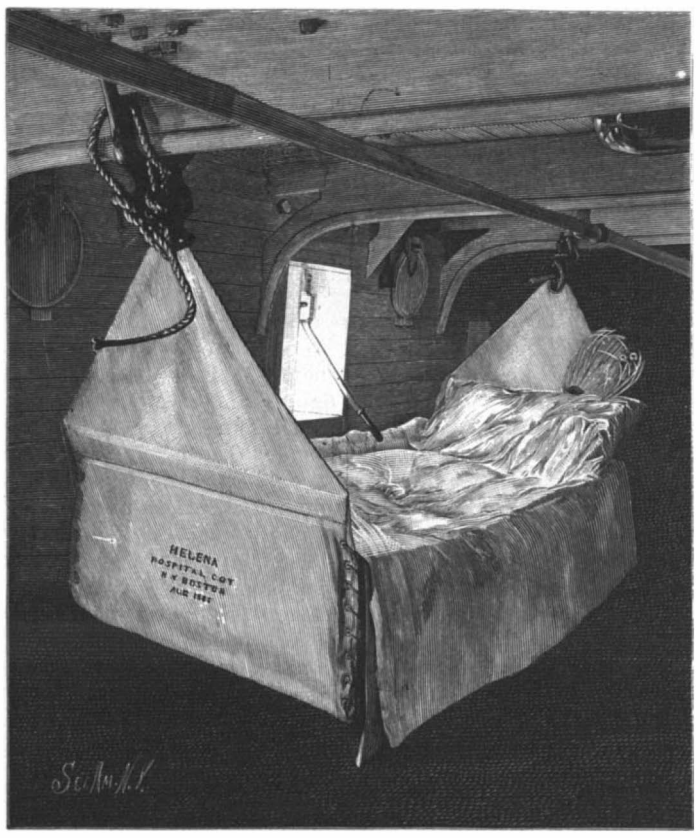
CARE OF THE WOUNDED IN SEA FIGHTS.

The requirements of modern naval warfare make it impossible to pass easily from one section of the ship to another during an engagement. This has caused the medical service in some navies, notably the French, to be decentralized as much as possible on each ship, centralization being left for the hospital ships and shore hospitals. In the old days of wooden ships with flush gun and spar-decks, it was comparatively easy to transport the wounded to where they could receive every surgical attention. The surgical staff was a unit, and its work was brought to it; but now all this has been changed, and they must seek it. A modern battleship is practically an aggregation of steel cells, each containing its quota of the crew, all working harmoniously and in concert toward the destruction of the adversary.

Anyone familiar with the construction of a modern battleship will readily see the impossibility of caring for wounded men as in the days of wooden ships; for, of course, the object of making closed compartments is to utilize them in this form when in action, for when a ship clears for battle the bulkhead doors are closed, and the men isolated in groups, as much so in fact as if they were in separate ships; so that it will be seen that it is manifestly impossible to carry the wounded men to a sick bay until the fight has ended; but everything is done to save life until those injured can be carried where they may be properly attended to. The fighting space in modern war vessels is so limited, especially in the turrets, that the immediate removal of disabled or wounded men is of the utmost importance, for there are no unoccupied spaces in which they can be placed out of the way of the actives. The only practicable method of caring for the injured is to lower them to the partially cleared space at the base of the turret, either by the ammunition hoist or lashed in a hammock. Here the unfortunate must remain, after receiving temporary aid, as the space is too limited for the performance of any operation, and it is doubtful if a surgeon could even reach him. But at the first favorable opportunity he is transferred to the sick ward, where proper medical attention is given, and he will be relegated to a cot, something similar to that in our illustration; but as soon as possible the wounded are transferred to a place where they can be still better cared for, such as is afforded by the ambulance ship "Solace," now with the fleet at Santiago, and which has already furnished efficient aid for many soldiers and sailors, ill or wounded.

As far as possible, each compartment of the ship is provided with emergency surgical appliances, and men rated as "nurses," under the direction of a surgeon's steward, do all possible to relieve the sufferings of the injured. The temporary surgical ward is usually a space especially set apart for this purpose. It may lie at the forward end of the berth deck, or in such other place as the exigencies of the situation may demand. Formerly the old operating room was the cockpit, which was considered the safest place on the ship; but now the table in the wardroom is usually assigned to the surgeons, as on Dewey's squadron during the battle of Manila. When there is a lull in the tide of battle, the wounded are brought as quickly as possible to the surgical table, where the necessary operations are taken in hand. Of course capital operations are only performed when delay would be fatal, and whenever possible those injured are transferred to a hospital ship or to a hospital on land, where they may receive plenty of light and air and proper nursing. With modern aseptic surgery, injuries which in the Civil War would have been fatal are now treated successfully.

Our engraving represents what is known as a hospital cot, and the cots which are used in the sick bays of war vessels usually partake of the characteristics of both a cot and a hammock. Of course, a cot of this kind would be used during cruises by those who became injured, so that the ordinary hammock would not answer. The cot consists of a frame covered with a mattress, and triangular pieces of canvas serve to attach it to the hammock hooks through the medium of ropes. Flaps hang down at the ends to prevent a draught from striking the patient. The blankets are placed on the cots in such a way that they may be thrown over the patient from each side, and are not used in the ordinary way. The peculiar form of cot shown in our engraving has been somewhat criticised by medical men, who say that it embodies none of the advantages of either the true naval hammock or cot, since here the equilibrium of the patient is constantly endangered, which is not the case in either of the latter. The ordinary ship's hammock is suspended in such a way as to gather it about the body of the individual resting therein. The danger of falling out is infinitesimal, except, perhaps, to those suffering from delirium. The true naval cot is suspended from four corners, and a web of canvas protects the occupant, regardless of the changes of gravity. It is feared that the cot hammock here illustrated will tip at any disturbance of the center of gravity; hence it would be materially improved by providing two more points of suspension.



A HOSPITAL COT ON A MAN-OF-WAR.

The "Solace" was formerly the "Creole," of the Cromwell line. She has a displacement of 3,600 tons, is 350 feet long on the load line, and has a speed of 14 knots. The ship carries powerful launches and barges for transferring the sick and wounded at sea. The idea is to have the "Solace" remain near the fleet while in action, and as soon as any ship withdraws, or at the close of the engagement, to take all the wounded on board and steam away for a naval hospital. Thus it will be seen that she is more properly an ambulance ship rather than a hospital ship. The injured are lowered into the steam launches and barges, and immediately on being received on board those requiring operation at once will be placed on the tables and then sent later to the wards.

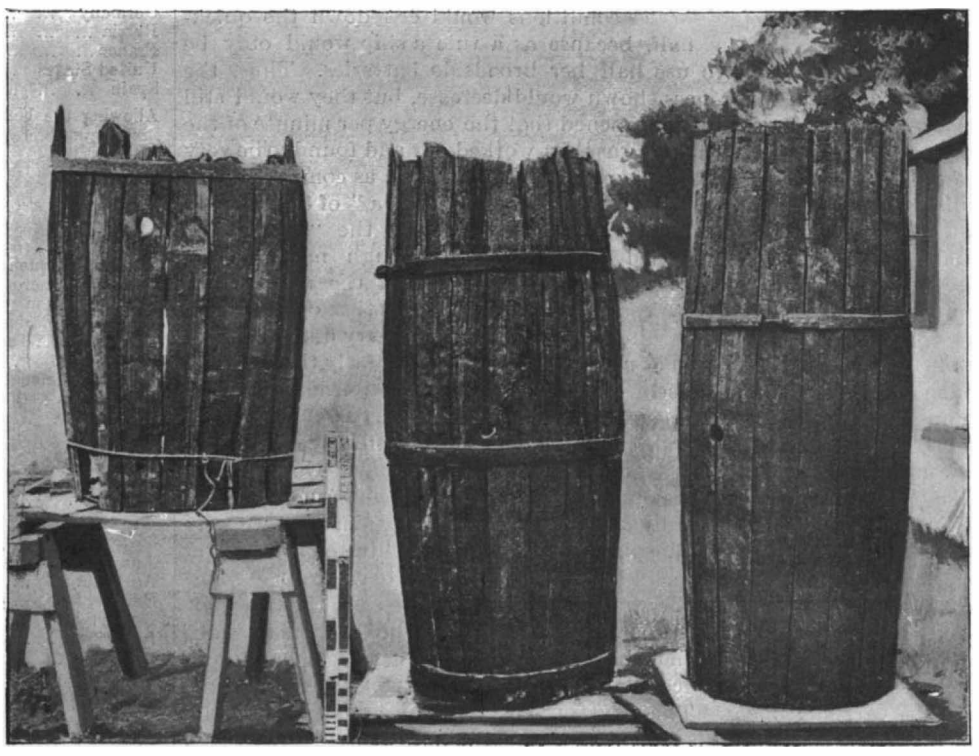
The operating room measures 30 by 30 feet and is well lighted and equipped with aseptic hospital furniture of the best pattern, and the outfit of instruments, sterilizers, etc., is complete in every detail. The floor of the operating room has even been paved with tiling. On the engine room deck is a fully equipped steam laundry and drying room and a disinfecting chamber for clothing. An ice machine and cold storage plant have also been supplied, as well as a large water distilling plant. The ship is equipped with three formaldehyd generators for disinfecting purposes. There are separate rooms for wounded officers, and the men are berthed in spacious wards in the forward and after part of the ship. There are four medical officers attached to the ship, three apothecaries, eight graduated nurses, laundrymen, cook, etc. The ship flies the Red Cross flag and is protected by the articles of the Geneva convention. She is painted white with a green stripe, as are each of her steam launches. It is the first war in which surgeons have had an opportunity to practice aseptic military surgery. There are seven hospital ships attached to the French navy, which has paid particular attention to this subject.

A Literary Treasure House.

The Genizah or treasure house of an ancient synagogue in Cairo is a windowless and doorless room at the end of a gallery, with an entrance through a big shapeless hole, reached by a ladder, says Biblia. Here, in obedience to the injunction upon the Jews not to destroy any of their sacred books, which finally came to include the preservation of all writings in the Hebrew characters, have been deposited, during the past two thousand years, worn-out and defective copies of such books, sound copies of "disgraced" books (that is, such as have once pretended to the rank of Scriptures, but have been authoritatively condemned as uninspired) and various Hebrew documents. Some parts of the immense mass, which includes books printed during the last four hundred years, are in a fair state of preservation; others are squeezed into unshapely lumps, while still others are "literally ground to dust in the terrible struggle for space." Dr. Schechter, of Cambridge, England, was able to rescue about forty thousand fragments of manuscripts, which have been placed in the library of the University of Cambridge, and are now being carefully examined. They consist mainly of parts of the Old Testament, some going as far back as the tenth century, of Jewish liturgical works, of the two Talmuds, very many hymns, legal documents, letters, prescriptions, amulets, and fragments of miscellaneous works.

ROMAN WINE CASKS DISCOVERED AT SILCHESTER.

In the rooms of the Society of Antiquaries, Burlington House, may just now be seen, says The St. James's Budget, some of the finds made last year by the explorers on the site of the Romano-British town of Calleva, in the parish of Silchester, which is about ten miles from Reading. The archæological value of the relics is great. At Burlington House one sees three venerable casks. Fifteen hundred years ago they held Italian wine. Some probes and other surgical instruments show that ancient Roman ideas on the form of such things were very like those of modern Englishmen. Then there are a fine bronze necklet and an eagle's head of the same metal from the top of a Romano-British staff. There are a few fragments of Samian pottery. The value of these potsherds lies in the clearness with which the maker's name still appears on them. There is a piece of imitation Samian "marble" which formerly decorated a mantelpiece. A stone jar, standing conspicuously in the middle of the room, is supposed to have been used as a store pot. It was found unbroken, built into the wall of a house. The collection also includes well preserved portions of querns, fragments of flint glass, pestles, and mortars.



ROMAN WINE CASKS DISCOVERED AT SILCHESTER ENGLAND.

Opening of the Harlem Speedway.

The new Harlem Speedway, which extends along the Harlem River from 155th Street to Dyckman Street, was opened to the public on July 2, without public ceremony of any kind. The driveway was opened last fall, but the speedway was closed again, as it was not completed and the road was in a bad condition. Plans for the construction of the speedway were approved in February, 1894. The work was let in two sections, one from 155th Street to High Bridge and the other from High Bridge to Dyckman Street. The second or upper section was finished first. The total cost of the driveway is $3,075,000. We have already described the speedway. See SCIENTIFIC AMERICAN for March 31, 1894, October 27, 1894, February 6, 1897, February 13, 1897.

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"The Engineer's" Analysis of American and Spanish Warships.

The SCIENTIFIC AMERICAN not unnaturally criticises an analysis made by us a few weeks ago bringing out certain features in American and Spanish warships. Some of its observations are fair and reasonable, and we are always obliged for any corrections in matters of fact. On such questions as the nationality of the crews of the United States vessels, the best information must come from America. We admit also that for blockade work even the slow monitors have their value. On the leading feature of our article, however, namely, gun power, we feel we must reply, the more especially as our contemporary remarks: "The fiction that our ships do not carry rapid-fire batteries is an old one with The Engineer, and, judging from the persistence with which it appears, it is as popular as it is abiding."

On this subject we may explain that, while we think that we never said that no quick-fire guns were carried, we have had in view a very definite deficiency, namely, want of power of serious fighting with quick-fire armaments. Originally light quick-firing guns were introduced in warships to defeat torpedo attack; then, as the power of larger quick-firing guns became apparent, came in batteries of pieces from about 4 inches to 6 inches in caliber, mounted behind medium or thin armor, intended to attack the unarmored or lightly armored parts of ships. So great a power was thus developed that, as we showed in our article in the end of 1895, ships deliver an enormous amount of energy of fire from quick-firing guns, and in a shape on which they can reckon more certainly than the few heavy blows delivered by the primary guns. It has been deliberately concluded by some of our highest authorities that our light unprotected quick-firing pieces, whose energy, moreover, is but small, could not be manned in close action unless circumstances specially favored it, so that their main function remains what it originally was, the defeat of torpedo attack or of men in boats.

The power of really heavy quick-firing batteries is not merely a very distinct feature, it is the main characteristic feature of new construction. Originated at Elswick, it quickly came into British armaments, then France, Germany, Russia, and other powers took up the question so keenly that, as shown in our article in 1895, England, in the actual amount of energy of quick-firers in occasional instances, does not now compare well with these powers. If, however, we take into account that the 6-inch quick-firing batteries in the most important types of British ships are mounted behind 6-inch Harveyed plates, and the pieces of most other powers behind 3 inches to 5 inches of ordinary steel, so that our own guns are secure while easily able to perforate most enemy's shields, it may be admitted that our quick-firing batteries ought not only to hold their own, but to have the best of it in a fight. Strange to say, the United States were slow to recognize the power of quick-firers used in the way we now speak of. This is now what we have to show, and we at once give our main facts. These are the strange deficiency of powerful quick-firing guns in all existing American battleships and armored cruisers, and the fact that last year for the first time a 6-inch quick-firing piece was introduced. For some reason which we do not attempt to account for, quick-firing guns were introduced in unarmored American ships, but while some of these are no doubt specially protected, no one can maintain that these vessels can take the place in close action that we are considering. The fact remains that this element of quick-fire was remarkably deficient in battleships and armored cruisers, and continues to be so to this day in ships afloat. For though at last the United States authorities have awakened to their need, it has been too late to get the benefit they would have had, had they not been behindhand.

We give herewith a list of battleships now afloat of the principal powers, with their quick-firing guns of the class we refer to, that is, from 3·9-inch (10-cm.) upward. We have taken ships approaching 10,000 tons displacement, and built between about 1891 and 1897—that is the time when this class of quick-fire was coming in. It will be seen that America has four battleships, of which only one has any quick-firing guns of the class we are dealing with, and these are only six in number and 4-inch in caliber. Spain has only one such battleship, the "Pelayo," who carries nine 5·5-inch quick-firing guns; that is, Spain's one ship carries 50 per cent more guns than the whole of the four Americans, and they are of much heavier caliber. Germany comes next with five battleships carrying twenty-four 4·1-inch quick-firing guns and eighteen 5·9-inch, besides four 9·4-inch, which last are of so heavy caliber that their rapid character might be questioned. Then follow Russia with six ships carrying eight 3·9-inch, thirty-six 5·9-inch, and eighteen 6-inch quick-firing guns; France with nine ships mounting eight 3·9-inch, seventy 5·5-inch, and ten 6·4-inch quick-firing guns; and lastly England with nineteen ships mounting twenty 4·7-inch and one hundred and eighty-six 6-inch quick-firing guns.

Our object is, however, not so much to take our stand on the total quick-fire gun power as on the extent of its recognition, which is represented by the average per ship. If, then, we take the energy per minute, and if, to be liberal, we allow the light 4-inch guns of America ten rounds per minute, and cut all heavier guns down to five per minute, the result is still absurd as a matter of comparison, the average 13,730 foot-tons energy of fire being less than $\frac{1}{4}$ of Germany, $\frac{1}{11}$ of Spain, about $\frac{1}{13}$ of France, less than $\frac{1}{12}$ of England, and hardly more than $\frac{1}{15}$ of Russia. Our American critic objects to the omission of coast defenders. Were we to throw them in in this comparison, however, America would suffer, as they are old-fashioned vessels, which among them all could only muster ten 4-inch quick-firing guns. Were we to take ships building and not afloat, we admit the matter would be greatly changed, and this will be the case next year. We, however, are at present answering the charge of running our head against a fallacy in articles written in the past: we are not charged with doing so in articles which we are going to write next year.

Being, however, brought to book, we are anxious to make good our so-called "fiction." First, then, as to battleships, we offer our figures and ask that they should be shown to be wrong. Failing this, is it a fiction to say that with a proportion on the most liberal allowance of rate of fire of from $\frac{1}{4}$ to $\frac{1}{15}$ the energy of fire of the average ship of the various powers mentioned, American ships are decidedly deficient in quick fire? "Do not carry quick-firing batteries" is not, we think, an expression we ever used, although three out of four battleships have none at all of the class we are dealing with. Next we come to armored cruisers. Of these we give lists of England, Germany, Spain and the United States, with an average showing the United States ships behind all the others, though not at all to the same extent as in the battleships.

With regard to unarmored ships, we admit that commencing in 1892, American ships appear to be well provided with powerful quick-fire guns. It is to armored battleships and cruisers our statement was made, and holds good. Our disregard of the small quick-firing pieces may be objected to. We can perhaps best meet this objection substantially by explaining to our readers exactly how the question of this element in armored ships came prominently to our notice. Near the end of 1895, as above said, we published diagrams showing energy of fire per minute of various British and foreign ships, taking "Excellent" rates for all as far as possible. An article in the "Naval Annual" in 1896 reproduced these figures, further carried out and corrected, and with several additional ships. In these were included the fire both of heavy guns and of all the light quick-firing pieces; but as the whole of the guns were given on both broadsides, so that the heavy guns did not carry the weight that should be assigned them in action, and as the light quick-firing pieces have insignificant energy, the figures shown chiefly depended on the heavy quick-firing batteries. In the shape in which they appeared, the rectangles showed actual facts and figures without the application of any judgment which might involve personal prejudice. The guns were simply entered as they stood; the energies were taken from tables and the rates from the "Excellent." The simplest application of service conditions would cut down the quick-fire by half, because as a rule a ship would only be able to use half her broadside batteries. Thus, the differences shown would decrease, but they would still exist. It happened that the energy per minute of the "New York" was then worked out and found to be very poor; in fact, only 119,904 foot-tons, as compared with 509,091 foot-tons for the "Esmeralda," of 500 tons less displacement. The rectangle for the "Brooklyn," with 247,940 foot-tons, which, though much better, was still very poor, was shown, but the reason that the "New York" was omitted was that our relations with the United States had been so very unsettled, and the aspect of matters had been sufficiently threatening, for it to seem undesirable to call attention to a fault which appeared so easy of correction.

We have always regarded the possibility of fighting with the United States with dismay. Nothing has been more opposite to our wishes; but American officers, as fully as our own, would consider that we were right in keeping such a point as this to ourselves at such a time. It was not necessary to take an extreme view in the way of caution, and, as said, the rectangle for the "Brooklyn" was shown in the "Naval Annual," but she had the largest quick-firing guns in the American service, and could not quickly get a heavier armament. The want of power of the 4-inch pieces could not, it is true, long escape the notice of such keen men as are to be found in the States, and was indeed mentioned elsewhere in the "Annual," but it seemed right to refrain from thrusting forward at the moment the great gain that would follow from substituting 5-inch for 4-inch guns. It is not always remembered that caliber tells as the cube. A 4-inch and 6-inch gun in a secondary armament are, of course, seen to be different things, but it is not grasped till tested that if their velocities are equal, the blows delivered are in **the ratios of four cubed and six cubed, or 64 and 216.** That this, as we say, has only been latterly appreciated in the States is surely apparent from the fact that only a few months ago was the 6-inch quick-firer gun adopted by the United States government. That it is now appreciated, however, is equally clearly seen in the armament laid down for the "Illinois" and "Wisconsin," two of the very class we have instanced as hitherto almost wholly deficient in powerful quick-firing guns, for each of these are to have fourteen 6-inch quick-firing guns. We have said nothing concerning the arrangements for "feeding" the guns; that is to say, supplying them with ammunition. This is, however, a most important point, and we are not at all clear that it has been fully worked out in the United States navy. Possibly our contemporary can supply information on this subject.

BATTLESHIPS.

Name.	Displacement in tons.	Q.F. guns of 3·9in. calibre and over.	Date of launch.
United States.			
Indiana	10,288	none	1893
Iowa	11,410	6 4in.	1896
Massachusetts	10,288	none	1893
Oregon	10,288	none	1893
Germany.			
Brandenburg	10,100	6 4·1in.	1891
Kurfurst Friedrich Wilhelm	10,100	6 4·1in.	1891
Weissenburg	10,100	6 4·1in.	1891
Wörth	10,100	6 4·1in.	1892
Kaiser Friedrich III.	11,130	4 9·4in. / 18 5·9in.	1896
Russia.			
Georgi Pobiedonosetz	10,280	8 3·9in.	1892
Petropavlovsk	10,960	12 5·9in.	1894
Poltava	10,960	12 5·9in.	1894
Sevastopol	10,960	12 5·9in.	1894
Tria Sviatitelia	12,480	12 6in.	1893
Sisoi Veliki	8,880	6 6in.	1894
France.			
Bouvet	12,200	8 5·5in.	1896
Brennus	11,395	10 6·4in.	1891
Carnot	12,008	8 5·5in.	1894
Charlemagne	11,275	10 5·5in.	1895
Chas. Martel	11,880	8 5·5in.	1893
Gaulois	11,275	10 5·5in. 8 3·9in.	1896
Jaureguibery	11,824	8 5·5in.	1893
Massena	11,924	8 5·5in.	1895
St. Louis	11,275	10 5·5in.	1896
England.			
Barfleur	10,500	10 4·7in.	1894
Cæsar	14,900	12 6in.	1897
Centurion	10,500	10 4·7in.	1893
Empress of India	14,150	10 6in.	1893
Hannibal	14,900	12 6in.	1897
Hood	14,150	10 6in.	1893
Jupiter, Magnificent, Majestic, Mars, Prince George	14,900	12 6in.	1897, 1895, 1895, 1897, 1896
Renown	12,350	10 6in.	1896
Ramilles, Repulse, Resolution, Revenge, Royal Oak, Royal Sovereign	14,150	10 6in.	1893, 1894, 1893, 1895, 1894, 1892
Victorious	14,900	12 6in.	1897
Spain.			
Pelayo	9,900	9 5·5in.	1887, 1897

MEAN OF LINE-OF-BATTLE SHIPS.

	Displacement, tons.	Q.F. gun energy per min.	Average date.
England	13,987	172,131	1894$\frac{8}{12}$
Germany	10,306	97,760	1892$\frac{2}{12}$
Russia	10,753	198,620	1893$\frac{8}{12}$
France	11,673	164,101	1894$\frac{6}{12}$
United States	10,564	13,730	1893$\frac{6}{12}$
Spain	9,900	151,695	1897

Allowing the United States guns ten rounds per minute and all others five rounds per minute.

ARMOURED CRUISERS.

Name.	Displacement, tons.	Q.F. guns of 3·9in. and over.	Date of launch.
Spain.			
Almirante Oquendo	7000	nil	1891
Cardenal Cimeros	7000	10 5·5in.	1896
Cristobal Colon	6840	10 6in.	1896
Emperador Carlos V.	9235	8 5·5in.	1895
Infanta Maria Teresa	7000	nil	1891
Numancia (New armament 1897)	7305	6 6·2in.	1863, 1897
Princesa de Asturias	7000	10 5·5in.	1896
Vizcaya	7000	10 5·5in.	1891
United States.			
Brooklyn	9215	12 5in.	1895
New York	8200	12 4in.	1891
England.			
Aurora, Australia, Galatea, Immortalité, Impérieuse, Narcissus, Orlando, Undaunted, Warspite	5600 to 8400	each 10 6in.	1889, 1888, 1889, 1889, 1886, 1889, 1888, 1889, 1888
Germany.			
König Wilhelm	9757	20 5·9in.	1868, 1896

The energy of fire per minute, allowing the United States 5in. guns six rounds and the 4in. ten rounds, and the English, German, and Spanish guns five rounds, gives the following average:—

	foot-tons.
German ships	370,300
British	167,800
Spain	128,484
United States	120,924

—The Engineer.

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GEARED LOCOMOTIVES ON THE MOUNT TAMALPAIS RAILWAY.

The geared locomotive has had a somewhat extended trial in this country and has proved itself to be a valuable means of traction under special conditions. It has found a field of usefulness in the West, where it has been used on logging and mining work, in which the grades and curvature are heavy and the track is of the rough-and-ready type. For this class of service the geared locomotive is admirably adapted. It has a large hauling power in proportion to its weight, and great flexibility.

To the mechanical sense there is, at first thought, something objectionable in the idea of introducing the complication of gearing into a locomotive; though the objection is more sentimental than anything else, and is due, doubtless, to the fact that we have come to associate the idea of high speed with the locomotive, and have rightly determined that a direct connection is superior to any other for fast work of this kind. On the other hand, it is a fact that excellent results have been attained in electric traction with geared motors, some of them of considerable size and power.

There are two classes of geared locomotives. In one of these the engines are placed vertically on the outside of the frame, and drive a horizontal shaft which extends along the side of the locomotive and meshes with gears formed on the faces of the driving wheels. In the other class the engines drive a shaft which lies beneath the boiler parallel to the axis, and carries bevel gears which mesh with gears on the driving wheel axles.

On our front page we give illustrations of a 30-ton engine of the central shaft class, which was designed by Mr. Charles Heisler, consulting engineer, of Erie City, Pa., and is running successfully on the Mount Tamalpais Scenic Railway, in California. The road, which was built purely for tourist purposes, runs from Mill Valley, a point near the Golden Gate, San Francisco Harbor, to a point near the summit of Mount Tamalpais, a distance of 8·25 miles. The grades are heavy, varying from 5 to 7 per cent, and there are about 275 curves, all of which are of from 70 to 75 feet radius.

The engine, as will be seen from the cuts, is carried on two trucks, one under the forward end of the boiler and the other under the tender, the tender and locomotive being built on the same frame. On the forward axle of the leading truck and on the rear axle of the trailing truck is secured a heavy bevel spur wheel which gears with a bevel pinion whose shaft is carried by a long bearing in a frame that is formed integrally with the inclosing gear case, the upper half of which is shown removed in Fig. 7. The frame is supported by a sleeve on the axle and is independent of the truck frame, thereby insuring that the gears shall be maintained at all times in proper alinement. The gear case, which is dust-proof, enables the gears to run continuously in a bath of oil. The other axle of each truck is driven from the main axle by means of coupling-rods, as shown in Figs. 6 and 7.

The pinion shafts are inclined and extend the length of the gear frame. At their inner ends they are connected by universal joints with the main crank shaft, which extends parallel with the axis of the boiler and just above the top of the inner axles of the trucks.

The cylinders, one on each side of the boiler, are inclined 45 degrees to the vertical and drive inwardly and downwardly upon the longitudinal crank shaft. Each cylinder is bolted to its own hollow cast frame, and the two frames are securely bolted together in the vertical longitudinal plane of the locomotive, the journals of the main crank shaft being formed in the bottom of the frame. The engine frames are carried by the locomotive side frames, the space between the top and bottom bars being considerably widened to admit them. In the Heisler engines of a larger size four cylinders are used, two on each side.

In designing these engines the boiler has been made of ample capacity, to avoid over-forcing when the engine is working up to its full capacity on heavy grades, and a large cylinder capacity has been provided to insure ability to start with the heaviest loads and maintain a good speed with economical consumption of steam.

The universal couplings are made of steel and phosphor bronze. They are clamped upon the shafts, and may be readily removed. They have only a slight angular movement and offer only a slight resistance to the swing of the trucks in passing around the sharp curves which abound on this railroad. The gear wheels are made unusually heavy, so that, even when they have become weakened by wear, they may be able to withstand the heavy shocks to which they are exposed.

The Mount Tamalpais Scenic Railway is situated in the southern end of Marin County, California, and, as its name suggests, it climbs the east peak of Mount Tamalpais, a rugged and picturesque mountain that attains an elevation of 2,537 feet above the sea in a distance of three miles. Marin County forms the north shore of the famous Golden Gate of the Pacific, and is bounded on the west by the Pacific Ocean and on the east by the Bay of San Francisco. The summit of the mountain is twelve miles northerly from the city of San Francisco and five miles easterly from the ocean.

The railway, which has a total length of 8·19 miles, is built to standard gage. The track is laid on ties 6 inches by 8 inches by 9 feet long and the rails weigh, 56 pounds per yard. It is thoroughly well ballasted, and ample superelevation is provided on all curves. Commencing at the little hamlet called Mill Valley (75 feet above sea level), which nestles at the foot of the mountain, the road ascends the valley of the Arroyo Corte Madera del Presidio in a northerly direction for a distance of about two miles, at which point the Arroyo is crossed by a trestle on a curve having a radius of 70 feet, with a total curvature of 182°. Continuing westerly along the face of the mountain for another two miles, winding in and out of many cañons, the "Mesa" is reached. Here the topography of the country compelled the engineers to overcome an elevation of 130 feet between points that were less than 800 feet apart in an air line. This was accomplished by means of what is now known as the "Double Bow Knot," where the tracks parallel themselves five times, the shortest radius of the curves at the turns being 75 feet. Here, at an elevation of 1,150 feet, the expanse of the Pacific Ocean breaks into view. Continuing westerly for a distance of two miles, the "West Loop" is reached at an elevation of 1,800 feet, where a remarkable turn of 252° is made, the radius of the curve being 80 feet and the grade 5·2 per cent. The road now stretches in an easterly direction and climbs to the Tavern of Tamalpais, which marks the end of the road at an elevation of 2,353 feet above the sea.

The average grade of the entire road is 5 per cent and the maximum grade attained is 7 per cent. The grades have been somewhat lightened on the curves to compensate for the increased resistance, but in a few instances a 6 per cent grade has been maintained upon curves of 70 feet radius. We are informed by Mr. George M. Dodge, chief engineer of the road, to whom we are indebted for the engineering data, that in this short line there are 21 wooden trestles having an aggregate length of 1,703 feet. One of these trestles is shown in our illustrations crossing the cañon already mentioned on a curve of 70 feet radius.

The excessive curvature may be judged from the fact that, out of the total length of 8·19 miles, the total amount of straight line is only 3·282 miles, while the curvature is divided as follows:

		Length.
26 curves of	70 feet radius	3,641 feet.
24 "	80 feet radius	2,974 "
20 "	90 feet radius	2,328 "
49 "	100 feet radius	4,020 "
46 "	110 to 150 feet radius	4,403 "
59 "	150 to 300 feet radius	4,710 "
42 "	300 feet radius and upward	3,837 "

There are in all 266 curves on the road, and it speaks well for the geared locomotives that they work very freely on the curves and show no perceptible wear on the wheel flanges.

An Acetylene Gas Exhibition in London.

An acetylene gas exhibition was opened by the Imperial Institute, London, June 15. Considerable pains were taken to make the exhibition a success as a practical exposition of the principles and practice of the production and use of acetylene gas. An influential committee was appointed, which drew up rules and regulations governing the exhibition. Generators were classed under three main heads: 1. Those in which the gas is generated by water being allowed to drop or fall in small streams on to the top of the carbide. 2. Those in which the water rises around the carbide. And, 3, those in which carbide falls into the water. Subdivisions were made into automatic and non-automatic generators. Acetylene apparatus was represented by twenty-seven exhibitors. There is a second department in which acetylene gas is made by generators which are duplicates of the ones already exhibited. The gas thus made is conducted from each machine to a lamp made by the owner and maker of the generator. A practical test of acetylene for illumination is made in another part of the building, and it is intended to make a test of the light itself as regards its effect upon color. Five rooms have been handsomely furnished and hung with oil paintings and engravings, and they are lighted with acetylene gas; therefore, the public has an opportunity of judging of the value of the new light, in presenting colors in their normal tints.

The Proposed Antarctic Exploration.

The Royal Geographical Society is much disappointed by the refusal of Lord Salisbury to supply government aid to the expedition in search of the South Pole. Notwithstanding this decision, the Royal Geographical Society has determined to raise a fund of $250,000 by subscription, for providing for the expenses of the expedition. $100,000 has already been promised. It has been proposed to send an especially equipped steamer in June next, and one of the purposes of the expedition will be to land a sledge party on Victoria Land, which will endeavor to penetrate the interior as far as possible and seek to locate the south magnetic pole.

Miscellaneous Notes and Receipts.

Waterproof Porcelain Cement.—Dissolve (1) 10 parts of mastic in 60 parts absolute alcohol; (2) 20 parts isinglass in 100 parts water and 10 parts grain brandy; (3) 5 parts gum ammoniac in 25 parts grain brandy; whereupon solutions 1 and 2 should be thoroughly mixed, No. 3 added, and the whole boiled down to 180 parts.—Neueste Erfahrungen und Erfindungen.

The cane bottoms of chairs can be rendered tight again by supporting the chair, moistening the cane seat thoroughly with very hot water by means of a sponge and washing off so that the cane-work becomes completely soaked. Then place the chair in the open air or, better still, in a strong draught and allow to dry The results will always be very gratifying.—Die Mappe.

A Process to Silver Porcelain consists in mixing together 120 grammes of silver nitrate, 20 grammes of mercuric nitrate, 30 grammes of sodium bromide, 10 grammes of bismuth oxide and 120 grammes of water, adding a little gum. Coat the places to be silvered with the mass, allow to dry and bake in the kiln. Then place the pieces in the electrolytic bath and precipitate the metallic silver on the prepared places. In a similar manner gilding may be done. The effects produced in this manner may be called handsome in every respect. —Offerten Blatt für Bijouterie, etc.

A Giant Barometer has been mounted at Paris in the tower of the St. Jacob's Church. It is 12·65 meters high and 2 cm. thick. The filling consists of colored water, which is prevented from evaporating by a layer of oil above. While a mercury column, about 760 mm. high, will keep an air column of the same cross section in balance, a barometer filled with water must be much longer, because mercury is 13½ times as heavy as water. On the other hand, the fluctuations of the liquid column with such large barometers are 13½ times as great as with mercury barometers, for which reason they are admirably adapted for scientific observations.—Deutsche Uhrmacher Zeitung.

New Porcelain.—A complete revolution would take place in the ceramic industry if a new process called "Thonguss" (clay casting) should be successful. The mass is not, as heretofore, worked cold upon the potter's lathe or pressed into a mould, but is finely ground after careful drying, then melted at about +3215° C. in an electric furnace and poured in a heated, fireproof casting mould. Glazing becomes unnecessary in most cases, if the walls of the mould are sufficiently smooth. Otherwise it is allowed to cool off after the solidification of the cast to about +1860° and finely powdered glass is thrown on in a uniform, thin layer. The advantage of the new process is said to consist (aside from the considerably reduced cost) in an almost complete prevention of the unforeseen shrinking of the mass on cooling; so that henceforth instruments of precision and accurately divided measuring vessels of every description can also be made from porcelain. By means of a still unpublished process, viz., the admixture of a suitable substance to the melted clay, the inventor expects to render the cooled mass pliable—malleable—and also to make a remelting considerably more difficult. A difficulty which still remains unsolved with the clay casting method is the colored decoration. Solid colored designs, such as the much employed onion pattern, can be readily pressed with suitable stamps on the melting glass layer which forms with the said glazing method, but one has not been successful, for instance, to produce in clay casting the popular coffee cups decorated with flowers by hand painting. — Pharmaceutische Centralhalle, through Neueste Erfindungen und Erfahrungen.

The "Windward" Sails.

The auxiliary steam yacht "Windward" left New York on July 2, for Sydney, Cape Breton, in command of Capt. John Bartlett, who has made four trips to the Arctic regions. Mr. Peary and other members of his party will join the "Windward" at Sydney. The "Windward" carried one of the two survivors of the six Esquimaux which Mr. Peary brought home last year. The "Windward" has 50 tons of provisions for the use of Mr. Peary and his men. From Sydney the yacht will go to Cape York, Greenland, where she will take aboard a party of 60 Esquimaux with their sledges and dogs. From there she will steam to Sherard Osborne Fiord, where a base of supplies will be established. As the expedition moves northward it will at 50 mile intervals establish other bases of supplies for use in case the party is forced to retreat. The "Windward" will return in spring to Sydney for stores.

Lightning Explodes Mines.

During the thunder storm of June 28, a bolt of lightning struck the switchboard at Fort Washington, which controls the mines in the Potomac River, exploding three of the mines and damaging the system. The mines were intended as a protection to the capital. The explosions were witnessed by a number of persons on shore and in boats, and the exhibition left no doubt as to the fate of any boat which may be near the mines when they are exploded. An investigation was at once begun to ascertain the extent of the damage.

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TWO INSECT SAMSONS.

BY JAMES WEIR, JR.

When Samson stood between the pillars of the temple of Dagon and "bowed himself," thereby occasioning the mighty pile to fall in ruins upon his head, as well as upon the heads of a multitude of his enemies, he evinced extraordinary and super-normal strength; yet it was my good fortune recently to witness exploits of great strength, by the side of which the captive Hebrew's avenging blow pales almost into utter insignificance. When I declare that the actors in these feats were two lowly "pinching bugs," I am afraid that some of my readers will declare that I am drawing on my imagination. And yet, that which I am about to relate can easily be verified by anyone who will take the trouble to investigate and to experiment.

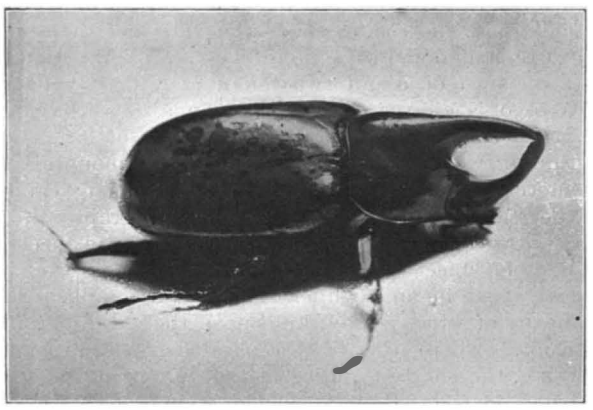
Last summer I went to a "cake walk" which was given at night in the city park. I had secured a good viewpoint and was enjoying the amusing antics of a couple of cake walkers when I felt something alight on the collar of my outing shirt. The entertainment was in the open air, the walking course being one of the footpaths of the park, which was brilliantly illuminated. I had noticed many moths and beetles flying about the lights; so knew at once that my visitor was a "bug" of some kind. I put up my hand and seized it, when, suddenly, a spasm of pain darted from my finger tips to my shoulder. In my agony and surprise I emitted a yell which occasioned the two cake walkers to execute several steps not down in their repertory. On examination, I found that I had got the tip of my middle finger between the mandibles of the largest stag beetle (Lucanus elephas) that I had ever seen. His mandibles were carefully pried apart by a friend and my finger released. It can be seen in the photograph what formidable weapons they are, though the beetle is here considerably reduced, it being, in life, 2¼ inches long and ⅝ of an inch broad. He is much more noticeable with his branching, staglike "horns" (which are not horns, but mandibles), broad, flattened, elephantlike head, and sturdy, polished legs and back, than the smaller female, whose mandibles are not branched and whose form is not so robust and formidable looking.

Unlike most of his congeners, the flight of Lucanus is almost without sound. I did not notice my visitor until I felt him on my collar. As soon as this beetle thinks that it is in danger of an attack from any source, it will hold its head erect and widely open its mandibles. Along the inner margins of the latter the horny skin is exceedingly sensitive. As soon as it feels anything between them, it closes them with considerable force and power, as I can testify from sad experience.

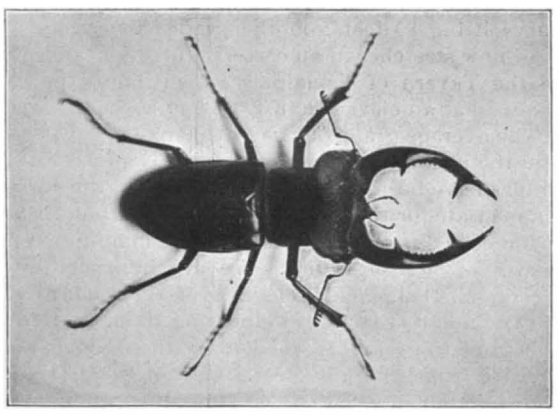
While holding this beetle in my hand, I was greatly struck with the extraordinary strength of his legs. When I closed my fingers upon him, taking care that none of them came between his sharp and ever ready "nippers," he seemed to plow his way through the hollow of my fist without the slightest difficulty. Procuring a little tin wagon which weighed exactly two ounces (960 grains apothecary's weight), I fastened him to it with a quick-drying glue and two pieces of thread. He weighed only 31 grains, yet he walked away, drawing the little wagon, as though he were free and untrammeled. I then placed half an ounce of bird shot in the wagon; he seemed to recognize this additional weight, yet pulled it along without difficulty. I added another half ounce. This seemed to be the limit of his load, for he could barely move the wagon, though move it he did for one inch. Just think of it! Here is a creature weighing only 31 grains which pulled 1,440 grains one inch, measured distance. Do you not think that his feat ranks with, if it does not surpass, that of the famous Samson? I do.

I confined all of his legs save one, which I attached to a very delicate dynamometer. This leg was fully extended and the animal was then irritated. It pulled down, as shown by the dynamometer, 249 grains. A man weighing 240 pounds would have to lift very near 2,000 pounds—one ton—with one hand or one leg in order to equal the performance of this beetle.

The rhinoceros beetle (Dynastes tityrus), the second insect Samson to which I invite attention, differs from the first in many respects. Lucanus is jet black, with wing cases and legs highly polished; it is slender, and sometimes very quick in its movements. Dynastes, on the contrary, is yellowish gray in color, with wing cases splotched with black; its body is heavy and solid looking, and its movements are always slow and sedate. Unlike those of the stag beetle, the horns on the head and prothorax of the rhinoceros beetle are true horns, and not mandibles. If the photograph of Dynastes be closely observed, it will be seen that the top horn springs from the back of the creature's neck, as it were, while the lower horn grows from the back of its head. These horns are fixed and immovable and can only be made to approximate by movements of the beetle's head. Near the base of the upper horn are two short, thornlike spines, one on each side. The female Dynastes is without horns, and is otherwise very different from the individual in the picture. The photograph is life size, and, since it is a very good one indeed, an accurate idea of the appearance of this mammoth beetle can easily be obtained from a study of it.



AN INSECT SAMSON—DYNASTES TITYRUS (RHINOCEROS BEETLE).



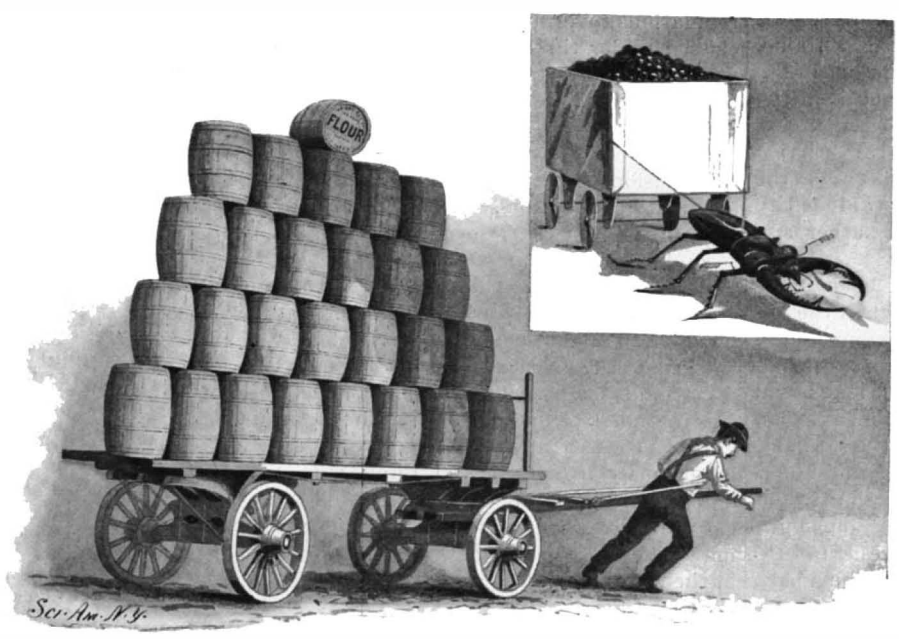
AN INSECT SAMSON—LUCANUS ELEPHAS (STAG BEETLE).

The set (or sets) of muscles governing the action of the mandibles of L. elephas is very highly developed and is exceedingly strong. Especially is this true of the tendinous attachments of the muscles themselves, which seem part and parcel of the mandibles, so closely and intimately are they welded to them.

The anatomical appearance of these structures indicates great strength. This appearance is reality, for relatively the elephant beetle has more power in its "jaws" than the most ferocious bulldog that ever gripped a bone. Furthermore, this insect has all the "staying" qualities of its canine prototype; for, once having seized an object between its powerful pincers, its head may almost be torn from its body before it will relax its grasp.

I held this beetle between thumb and forefinger of my right hand, and then brought the tip of my left thumb between its mandibles. These closed at once on the hard and calloused skin, the tips piercing through and through and meeting beneath the surface. By exerting no little force, during the exhibition of which the cervical attachments underwent considerable strain, the mandibles were dragged through the skin. Not till then did the creature separate them.

These members are powerful weapons of offense and defense, and one should carefully avoid them when examining this insect Samson.



RELATIVE STRENGTH OF MAN AND BEETLE.

The larva or grub of Dynastes is the largest of all the beetle grubs. The individual I have is very near two years old and will pupate during next winter. It will emerge a fully developed rhinoceros beetle about next May or June. When this grub is first hatched out, it is quite active, boring and eating its way through wood that is just beginning to decay. As it grows older, it becomes sluggish and seeks wood that is softer and more decayed; finally, just before it pupates, it seeks the rotten dust and broken up detritus of the cavity and there undergoes further metamorphosis. The grub was reared from the egg.

This giant among beetles is remarkably strong. After fastening it to the tin cart mentioned elsewhere in this paper, I placed in the little vehicle one ounce of bird shot. The beetle pulled this along without difficulty. I then placed a half ounce more of shot in the cart. This seemed to bring out the strength of the insect, for it bent to its work and clearly showed that it felt the additional weight very materially. Again I added a half ounce of shot. This seemed at first to bring the load to a weight beyond the creature's strength, but when I goaded it with an electric needle, it "bowed itself," even as Samson did between the pillars of Dagon, and pulled this, to it, enormous weight of one thousand nine hundred and twenty grains, a measured distance of two inches! The beetle weighed only one hundred and eight grains; consequently, it moved a weight eighteen times greater than its own. To equal this feat I would be compelled to drag a wagon and load which together weighed four thousand five hundred pounds! When we take into consideration that two thousand pounds is a heavy load for two strong draught horses, we can appreciate all the more what a wonderful exploit this was. This beetle showed a dynamometric strength of three hundred and ten grains for one of its fore legs.

In order to further test this insect's strength, I gently placed on its back a common paving brick weighing some four or five pounds. The beetle moved this brick perceptibly to and fro. If a man were to be subjected to a like experiment, the brick being as large in proportion to him as it was to the beetle, he would be crushed into a shapeless mass.

THE UNITED STATES ARMORED CRUISER "BROOKLYN"

Until the story of the naval engagement off Santiago has been written by some naval expert who was present at the fight, and written with a view to giving the facts which are of the greatest technical value, we shall be in ignorance as to which of the American ships bore the brunt of the fight. By one eyewitness the "Iowa" is reported to have been the chief object of attack, and another witness reports that on account of her superior speed the "Brooklyn" was singled out by the Spanish cruisers, and an attempt made to disable her. The fact (if fact it be) that she was hit forty times seems to substantiate the latter statement; moreover, it would be natural for the cruisers, whose sole effort seems to have been to escape, to aim at disabling the speediest ship of the enemy, and the only one that was capable of overhauling them provided she was not disabled.

The "Brooklyn" is the most modern of the large cruisers of our navy. She was modeled on the lines of the "New York," but exceeds her in size, speed, coal endurance and the power of her batteries. Both of the ships are of the armored cruiser type, and they constitute the sole representatives of this type in our navy.

The dimensions of these two vessels are given below.

Both ships have three funnels, and with their lofty freeboard present a commanding appearance. The "Brooklyn's" funnels are abnormally lofty, their extreme height being intended to serve the purpose of forced draught.

The forward pair of 8-inch guns in the "Brooklyn" are carried upon a raised forecastle deck, and the great height of the deck above the waterline gives the ship a peculiar contour from which she is easily recognized.

She was built by the William Cramp and Sons' Ship and Engine Building Company, of Philadelphia, Penn., from government designs, the contract price being $2,986,000, of which it was estimated that the machinery would cost $986,000, the remainder being for hull and fittings. Proposals for the construction of this cruiser were issued on September

	Length.	Beam.	Draught.	Displacement.	Horse Power.	Speed.
	Ft. In.	Ft. In.	Ft. In.			Knots.
"Brooklyn"	400 6	64 8¼	24	9,215	18,769	21·91
"New York"	380 6½	64 10	23 3½	8,200	17,401	21

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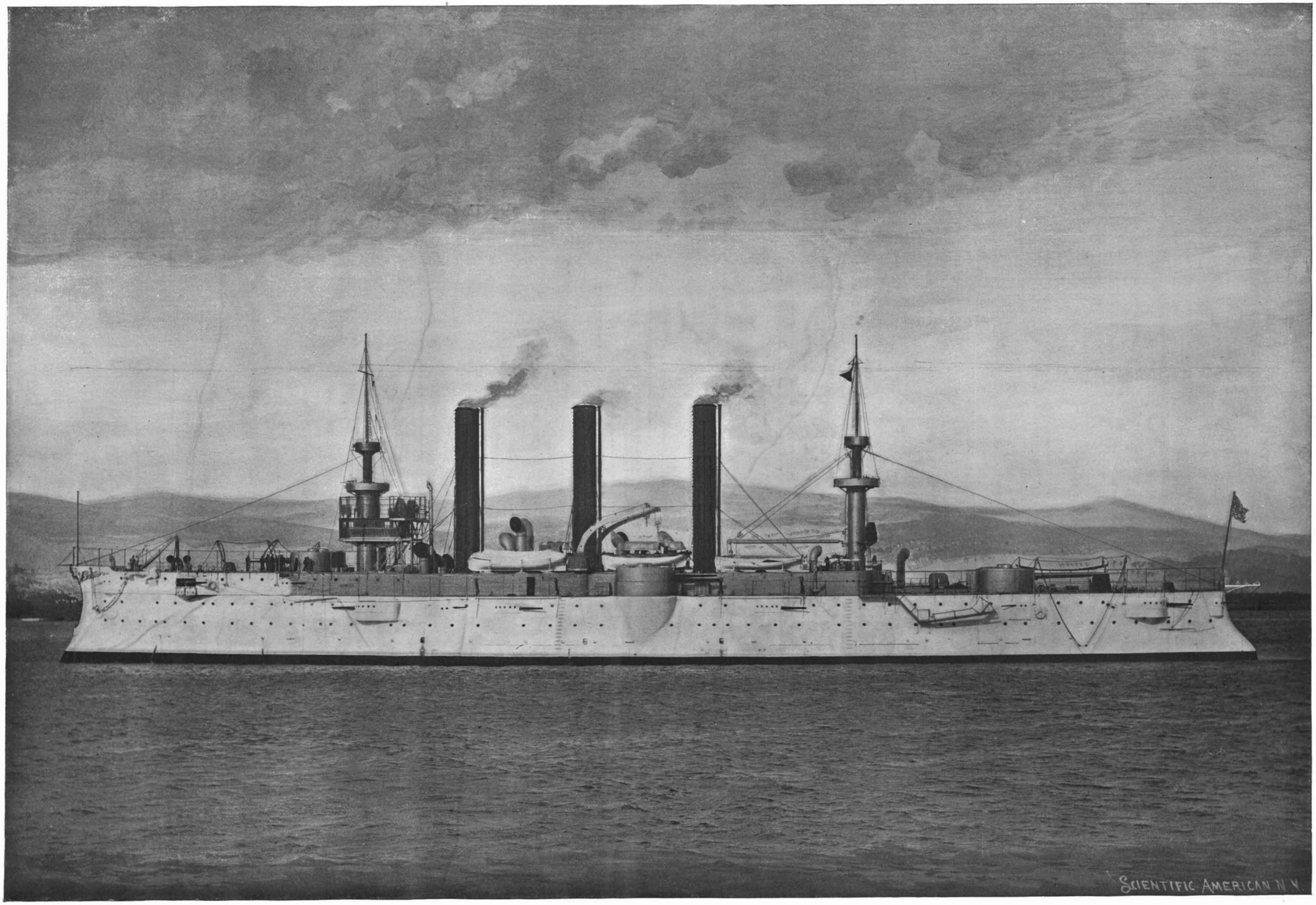

UNITED STATES ARMORED CRUISER "BROOKLYN."

DISPLACEMENT, 9,215 tons. SPEED, 21·9 knots. MAXIMUM COAL SUPPLY, 1,461 tons. COMPLEMENT, 516. ARMOR: Belt, 3 in.; barbettes, 8 in.; turrets, 5½ in. GUNS: Main battery, eight 8-in., twelve 5 in. rapid-fire; secondary battery, twelve 6-pdrs, four 1-pdrs., four Colts, two field guns. TORPEDO TUBES, four. AUTHORIZED 1892.

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28, 1892, bids were opened on December 15, 1892, and the contract awarded on February 11, 1893. The contract requirement as to speed was that the vessel should maintain a speed of 20 knots for four consecutive hours on a displacement of 8,150 tons and with an air pressure in the fire rooms not exceeding 2½ inches, it having been further stipulated that a premium of $50,000 should be paid to the contractors for every quarter knot made in excess of this requirement, and that a penalty of $50,000 should be exacted from them for every quarter knot deficiency.

By the successful completion of the speed trials on August 27, 1896, the builders received a premium of $350,000.

The hull is built of mild steel, which, like everything else in the vessel, is of domestic manufacture.

It is divided into 242 water-tight compartments. There is a double bottom, 3 feet 6 inches deep amidships, divided into 13 water-tight compartments, and extending from frame No. 22 to frame No. 82 and about 29 feet outboard. There is a cofferdam on each side, 3 feet 6 inches wide, extending the whole length of the ship between the protective and berth decks. This cofferdam is filled with cellulose at a density of 7·5 per cubic foot. The transverse and wing bunker bulkheads are carried through the cofferdams and divide them into water-tight compartments.

Length between perpendiculars, feet and inches	400-6
on L. W. L., feet and inches	400-6
over all (including rudder), feet and inches	402-7½
Beam, extreme, and at L. W. L., feet and inches	64-8¼
Ratio of length to beam	6 to 1
Depth in hold from top of main deck beams to top of floor, feet and inches	33-10 3/16
Draught, forward and aft, seagoing trim, feet	24
Displacement, seagoing trim (load draught), tons	9,271
per inch, at L. W. L., tons	41·19

The protective deck armor over the machinery space consists of two courses of 1½-inch steel plates. Forward and aft of this, the total thickness of the two plates is not less than 2½ inches. The protective deck extends the whole length of the ship. Glacis plates, 3 inches thick, are fitted around the engine hatch.

The side armor is 3 inches thick, and extends from 4 feet above to 4 feet below the 24-foot water line for a length of about 192 feet opposite the engine and boiler spaces. The barbette armor of 8-inch turrets is 8 inches thick, with a thickness of 4 inches where not exposed. The turret armor is 5½ inches thick, secured to a backing plate of 20 pounds per square foot. The side armor, turret armor, and barbettes are of Harveyized nickel steel.

The armor of the 5-inch gun sponsons is 4 inches thick, and the splinter bulkheads, 1½ inches thick. The secondary battery protection is 2 inches thick.

The conning tower and shield are of forged steel, 7½ inches thick; from the center of the conning tower an armor tube, 5 inches thick and 12 inches in internal diameter, runs down into the forward handling room.

ARMAMENT.

There are eight 8-inch guns mounted in pairs in four turrets. The guns in the forward and after turrets have an angle of fire of 290°, or 145° on each side of the bow and stern.

The midship guns have an angle of fire of 180° from right ahead to right astern. There are twelve 5-inch rapid-fire guns mounted in sponsons on the gun deck. There are, in addition, twelve 6-pounders, four 1-pounders, and four machine guns. The 1-pounders and machine guns are mounted on the rails and in the tops.

The ammunition is supplied by electric hoists, ten in number. There are four above-water torpedo tubes, two on each side, for firing Whitehead torpedoes. The air compressors are of the Rand Drill Company's three-stage type, and, together with the accumulators, are situated in the forward and after handling rooms.

The ship is driven by four vertical, direct-acting, three-cylinder, triple-expansion engines, placed one in each of four separate watertight compartments, connected by five watertight doors.

There are two engines on each shaft and, in place of the disconnecting coupling fitted on the "New York," there are four taper coupling bolts, the coupling being of the ordinary disk kind.

The I. P. and L. P. cylinders are fitted with steam jackets. The valves are of the single ported, piston type, made of cast iron, one for the high pressure and two each for the intermediate and low pressure cylinders. The low pressure valves are balanced by making the upper ends 1½ inches larger in diameter than the lower, the live steam being between the ends. The other valves are fitted with balancing pistons, connected above with the condensers. The valve gear is of the double bar Stephenson link type. The cut-off can be varied from about 5 to 7 of the stroke by means of a slot in the reversing arm.

Reversing is effected by a Cramps' steam reversing gear, which consists of a steam lift secured to one of the engine frames, and connected to an arm on the reversing shaft. The lifting piston is operated by a piston valve which is controlled by a floating lever, receiving motion at one end from the hand lever, and a reverse motion at the other from a pin on the crosshead, so that the piston moves and stops with the hand.

Each engine is fitted with a disk stop valve, having a screw stem and a balancing piston, and a butterfly throttle. The former is 12⅜ and the latter 14 inches in diameter. The main pistons are of cast steel, dished, and fitted with two packing rings, each ⅝ inch wide and ¾ inch deep, and the followers are grooved.

The engine frames are of the inverted Y type, of cast steel, two for each cylinder; each frame is made in two sections which are bolted together in the vertical plane. Cast on the inside of each frame are ribs and facings to which the cast iron crosshead guides are bolted. The space between the frame and the guide is used for water circulation. The bed plates are of cast steel of I section, each in three sections, bolted together. The bed plates of forward engines are fitted like a pillow block and its wedge, so that the forward shaft may be adjusted to the after engine shaft whenever the bearings wear down.

Shafting and Bearings.—The crank, thrust and forward sections of the propeller shafts are of forged steel; the after sections of the propeller shafts are of nickel steel. The crank shaft of each engine is in three sections, the cranks being bolted to each other at angles of 120°, and the sequence for ahead motion being H. P., I. P., and L. P. The two engines on each shaft are coupled with the H. P. cranks opposite each other. The after couplings of the L. P. crank shafts are of the same dimensions as those of the after engines. The couplings are fitted with tapered, headless bolts, and split pins over the nuts. There is no shaft alley, the thrust shaft coupling direct to the after section of crank shaft of the after engine.

Where the propeller shafts pass through the couplings forward and the propellers aft, the 11-inch hole is reduced to 4 inches in diameter.

Main Condensers.—The main condensers, one for each engine, are made of cast brass, each in five sections, including the water chests. The water circulates through tubes. Brass baffle plates are fitted to direct the steam over the tubes, and plates are provided for supporting the tubes and also to act as baffle plates. The tube sheets are made of rolled brass, 1 inch thick. The tubes are packed with cotton tape set up by screw glands, and are spaced 15/16 inch between centers.

Main Air Pumps.—There is one double, vertical, single acting Blake air pump for each main engine, fitted with the Blake valve gear. Both pumps on one side are connected to both condensers on the same side with intervening straightway valves, and exhaust into either the condensers or the I. P. or L. P. valve chests.

These air pumps are of the same style as fitted on the "New York," "Columbia," "Minneapolis," and other ships, and their successful working has been described in previous reports of trials.

Main Circulating Pumps.—There is a centrifugal, double inlet circulating pump for each condenser, arranged to draw either from the sea, from the bilge of its engine room, or from the main drainage pipe. The sea and bilge injection valves are fitted with a safety lock, so that both cannot be open at the same time.

Screw Propellers.—The propellers are of manganese bronze, and are three-bladed, true screws. The blades are bent back and are adjustable from a pitch of 19 feet 6 inches to 22 feet 3 inches. The hubs are spherical and fitted with conical tail pieces. The starboard propeller is right, and the port one left handed.

Steam is supplied from five double ended and two single ended steel boilers, all 16 feet 3 inches in diameter. Four of the double ended boilers are 18 feet, and the fifth, 19 feet 11½ inches in length. The single ended boilers are both 9 feet 5 inches long.

The working pressure of all boilers is 160 pounds per square inch. There are four Fox's corrugated furnaces in each end of each double ended boiler and four in each single ended boiler.

The boilers are all below the protective deck and placed in three watertight compartments, separated by two athwartship bulkheads. Two double ended boilers are placed in the forward, and two in the after compartment. In the middle compartment, the larger double ended boiler is on the port side, and the two single ended, placed back to back, are on the starboard side.

The longitudinal shell seams of the boilers are treble riveted with double butt straps. Joints of boiler heads and shell seams are double riveted, and the other circumferential seams are lapped and treble riveted. The front and back heads of all boilers are curved at the top; the radius for the double ended boilers being 3 feet 10 inches, and for the single ended boilers, 3 feet 2 inches. The boiler tubes are of charcoal iron, lapwelded and drawn.

The furnaces are fitted with Cone's patent cast iron shaking grates. There are 8 grate bars in each furnace of the main boilers, each bar extending the whole length of the furnace. They rock on lugs on the front and back bearers and on projections on the middle bearers, and can be easily renewed without hauling fires.

The boilers are fitted with a steam circulating apparatus, and the internal feed pipes are arranged to distribute the feed water throughout the boilers.

The figures of heating surface are as follows:

Heating surface, tube, square feet	28,332
furnaces and combustion chambers, square feet	5,100
total, square feet	33,432
Grate surface, square feet	1,016·2
Area through tubes, square feet	155 86
Ratio, total H. S. to G. S.	32·9 to 1
area through tubes to G. S.	0·153 to 1
total area of smoke pipes	1·26 to 1

Forced Draught.—The closed fire room system is used, there being in each fire room two Sturtevant blowers, each driven by a double engine. The diameter of the steam cylinders is 5 inches and the stroke is 4 inches. The diameter of the fan is 60 inches and its width 18 inches.

Feed Pumps.—There are three main and four auxiliary Blake feed pumps in the fire rooms. Both the main and auxiliary feed pumps are so connected that any pump will supply any boiler, but there is no connection between the main and auxiliary systems. There are also independent connections with the feed tanks.

Turning Engines.—In each engine room there is a double cylinder vertical, simple engine, with cylinders 7 inches in diameter and a stroke of 7 inches, secured to the engine frame, for turning the main engines. It operates on a worm wheel on the line shaft through bevel gears and a worm. The worm is made to slide on a feather key, and is held in place by a collar below and a removable key above it. A double pawl ratchet is fitted to the shaft of this engine for turning by hand.

Turret Turning Engines.—The forward and starboard turrets are turned by electricity, the port and after turrets, by steam. The steam turning engines are double vertical engines, with cylinders 8 inches in diameter and a stroke of 7 inches. They are capable of turning the turret at the rate of one revolution per minute with the guns run out and the vessel heeled 10°, with a steam pressure of 100 pounds per square inch. At a recent trial, the steam gear worked slightly better than the electric gear, but the result of the rivalry between the steam turned turrets and electrically turned turrets has no doubt been beneficial, as the present steam gear is believed to work much better than any steam turning gear that has been used in our service.

The steam gear is worked by a lever in the sighting hood; this lever, by appropriate mechanism inside of the ammunition tube, moves a change valve on the engine. The "follow up" gear has been abandoned, and the automatic stop, which is necessary to prevent the turret going too far, is provided by cams which are fastened to the bottom of the revolving turret tube. As the turret nears its extreme position, the cams are brought to against a fixed arm connected to the valve gear. These cams close the valve gradually, and the turret will stop at the same point, regardless of the speed of rotation.

All ammunition hoists are electrical.

OFFICIAL SPEED TRIAL.

The official speed trial took place on Thursday, August 27, 1896, on the measured course off the New England coast, between Cape Ann and Cape Porpoise. The weather was fine and the sea smooth, making the conditions most favorable. The first run over the course was made in 1 hour, 54 minutes, and 42·52 seconds. The turn, made without change in the speed of the engines, occupied 20 minutes and 53·85 seconds. The return was made in 1 hour, 52 minutes and 26·34 seconds. A tidal correction applied to the 83-mile course reduced the latter to 82·953 nautical miles.

The machinery worked smoothly and without water on any journal, except that circulating through the bearings. Indicator diagrams were taken every half hour from each main cylinder, and once an hour from the main air and circulating pumps. No difficulty was found in keeping the steam pressure up to the desired point without running the blowers at too high a speed. The ease with which the steam pressure was maintained was no doubt due, in a great measure, to the high smoke pipes. All boilers were in use and under forced draught. The coal used was Pocahontas of good quality.

DATA OF TRIAL.

Draught at beginning of trial, forward, feet and inches	21-6	
aft, feet and inches	22-3	
mean, feet and inches	21-10½	
Displacement at above draught, tons	8,150	
Average speed, knots	21·9117	
	Starboard.	Port.
Revolutions per minute, main engines	136·2	134·9
mean of both engines	136·55	
Piston speed, feet, per minute	953·4	958·3
Steam pressure, boilers, per gage	158·3	
engines, per gage	158·5	157·4
Vacuum in condensers, inches of mercury	25·5	24·9
Opening of throttle	Wide.	
Cut-off in decimals of stroke from beginning, H. P.	0·74	0·74
I. P. and L. P.	0·70	0·70

The total indicated horse power for all four engines was 18,248. We are indebted for many of our particulars to the builders, William Cramp & Sons, and to Passed Assistant Engineer W. C. Herbert, U.S.N.

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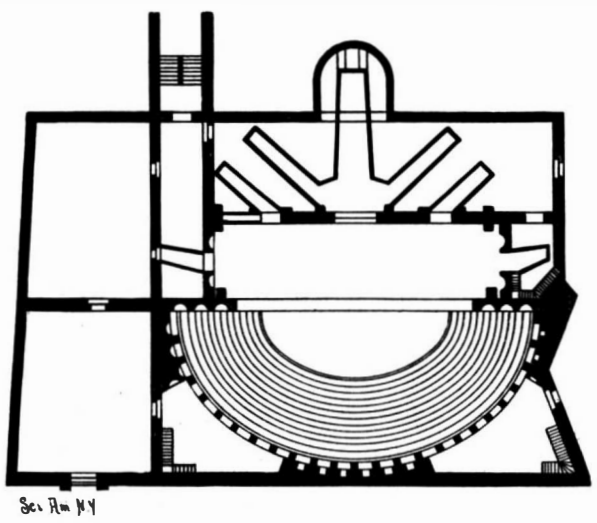
THE OLYMPIAN THEATER OF PALLADIO AT VICENZA.*

The oldest permanent theater in Europe, at least of those built since the time of the Romans, is the Olympian Theater at Vicenza, Italy, and it is the last of its race. Before considering this curious theater it would, perhaps, be well to glance for a moment at the history of the theater in ancient and modern times. In the old Greek theater the spectators were seated in a semicircle in front of a raised platform on which a fixed architectural screen was provided. The action took place upon this stage. The dramas of the Greeks and Romans were of the simplest kind, the dialogue being simple, rhythmical, and often intoned. The amphitheater, in which the seats rose in tiers, could accommodate a large number of spectators. A theater with a radius of three hundred feet could seat twenty thousand spectators. The best counterparts of the Greek theater are some of the concert halls which were built specially for oratorios and concerts. The Greeks fully understood that the facial expression of the actors was lost, the spectators being so far away from the scene of the action of the drama. They attempted to overcome these difficulties by requiring the actors to wear masks with strongly marked features, and to increase their height they were provided with high-heeled shoes. The opera glass in the modern theater has of course done away with all objections of this kind.

The modern theater is the result of the blending of the old circular theater of the Greeks with the rectangular theater (so-called) of the middle ages. The earliest mediæval theaters in Italy and Spain consisted of courtyards with balconies which were impressed into the service, and plays were often performed in churches; but in France the climate was so bad that the tennis courts were used. The trouble with the tennis court was that, owing to the difficulty of roofing a large open space, the room could be only forty or fifty feet wide, and only six hundred to one thousand persons could see and hear to advantage. The accommodations had to be increased by tiers of boxes. The conch-like arrangement of classical times was soon found to be unfit for a spoken dialogue, which cannot be well heard more than seventy-five or eighty feet away, or the expression of the actors' faces appreciated at a greater distance; so that the next improvement was the rounding off of the corners of the room and the multiplication of boxes, which were placed tier upon tier in the same manner as high office buildings are erected, to give increased accommodation, owing to the smallness and great value of some of our city blocks. In 1675 Fontana invented the horseshoe form of theater, which has not been departed from. In opera houses and lyric theaters the curve is elongated into an ellipse with the major axis toward the stage. In theaters for the spoken drama, where people must see and hear, the contrary process was necessary, and the front boxes were brought near the stage. The introduction of painted movable scenery seems to have been due to Baldassare Peruzzi, who used it in 1508 in the production of "La Calandra," which was played before Leo X. Further improvements led to the necessity of a recessed stage with a framing like that of a picture. Such is in brief the development of the modern theater.

SCENE AT THE OLYMPIAN THEATER AT VICENZA.

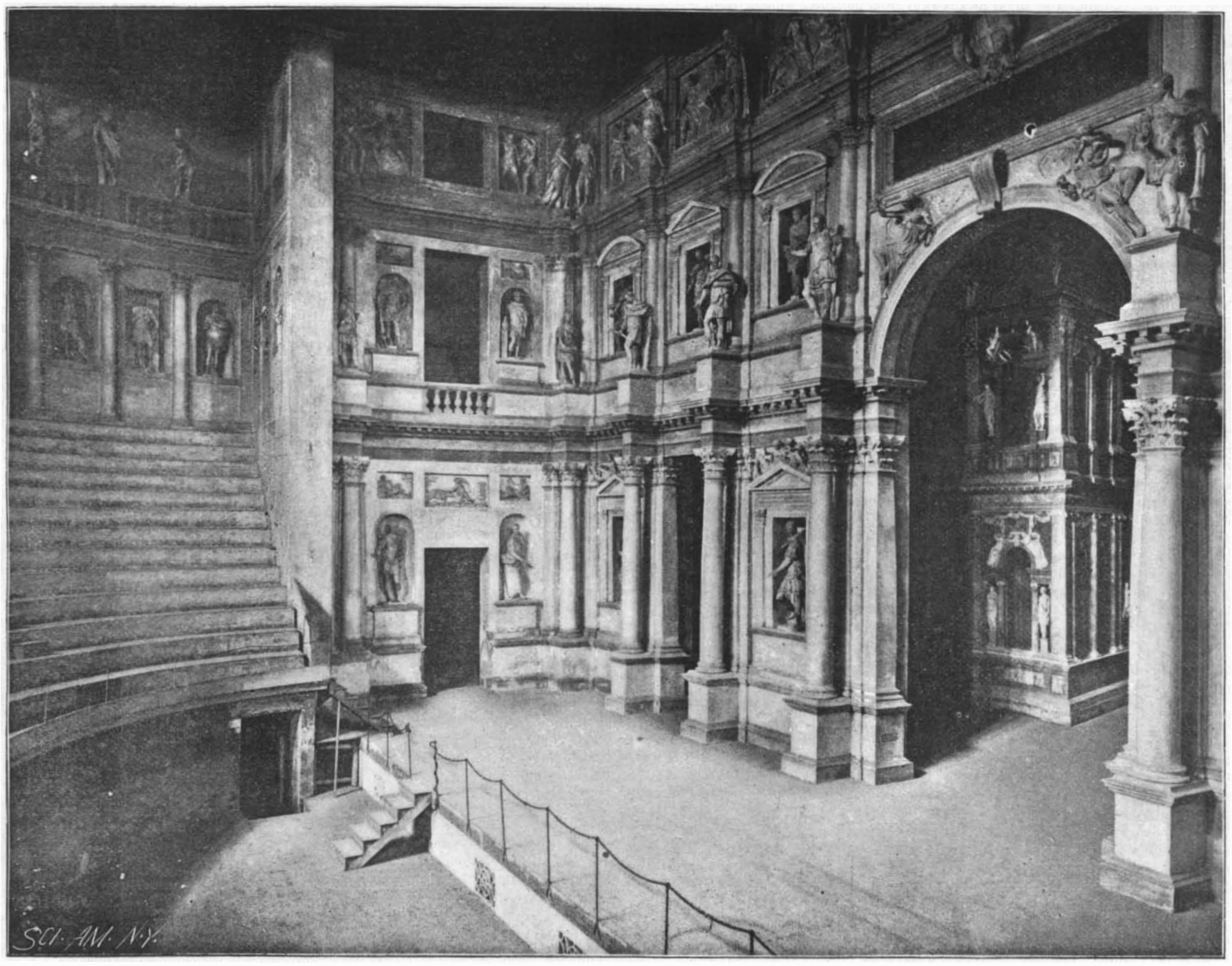


PLAN OF THE OLYMPIAN THEATER AT VICENZA.

Palladio (1518–1580) was probably a native of Vicenza, a town in northern Italy, forty-two miles west of Venice. He was an architect of the first order, and it is difficult to mention any architect who exercised a greater influence on the men of his time, as well as on those who succeeded him. He was an enthusiastic student of antiquity, and, fascinated by the stateliness and charm of the buildings of ancient Rome, he did not reflect that reproductions of these, even when they possessed great archæological accuracy, were often lifeless and unsuited to the uses of the sixteenth century. His writings and architectural work rendered it easy for those who came after him to reproduce buildings which were faultless in their details, but which were cramped, formal and cold. The Certosa of Pavia would have been impossible in London, yet, under the inspiration of Palladio, Sir Christopher Wren was enabled to construct in London the Cathedral of St. Paul, which would have done honor to the great Italian master himself.

Palladio died before the theater at Vicenza was completed, and it was finished, though not altogether after the original design, by his pupil and fellow citizen Scamozzi. It was an attempt to reproduce the classic theaters of Greece and Rome, and his friends assisted him by sending designs of antique buildings to help him. It consists of an auditorium under an awning in the form of a semi-ellipse, it not being possible, from the narrowness of the situation, to use a semicircle. Its greater diameter is ninety-seven and one-half feet and its lesser as far as the stage is fifty-seven and one-half feet.

Fourteen ranges of seats for the spectators follow the curve of the ellipse. At the summit of these receding steps, or seats, is a corridor of the Corinthian order, which, from



PALLADIO'S OLYMPIAN THEATER AT VICENZA.

*By Albert A. Hopkins. From "Magic: Stage Illusions and Scientific Diversions including Trick Photography." Copyrighted. 1897, by Munn & Co.

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the narrowness of the ground, could not be detached from the outer wall at all places. Palladio therefore filled up the nine center and the three external columnations, where the statues touch the external wall, with pieces of statuary.

The orchestra is five feet below the seats. The scene, which is sixty feet broad, is an architectural composition of two orders of the Corinthian style superimposed, which are surmounted in turn with a light and well-proportioned attic. On the stylobate of the second story are placed statues, and the intercolumnations are enriched with niches and statues. The panels of the attic are ornamented with reliefs of the "Labors of Hercules," and the center panel over the largest of the three openings in the proscenium, which is arched, with a representation of an ancient hippodrome. Over the arch is the following inscription: "Virtvti ac Genio Olympicorvn Academia Theatrvm hoc a Fvndamentis Erexit Anno MDLXXXIIII. Palladio Archit."

In the lower order the middle interval has a high open arch and the two others, on the side, have square openings through which are seen streets and squares of stately architecture, each ending in a triumphal arch. The position of the diverging avenues will be understood by reference to the plan. The magnificent palaces and private dwellings which are here portrayed furnish a very effective setting for the plays which were performed in the theater. Though the distance to the back of the theater is only forty feet, yet by skillful and ingenious perspective and foreshortening it appears to be four hundred feet distant. For this skillful and ingenious conceit, which is unclassical in spirit, we are indebted to Scamozzi. The existing ceiling, painted by Picutti, dates from 1828, in imitation of the velarium or awning of the Roman theaters. The old ceiling was removed, as it was falling to pieces. The exterior of the theater is by no means comparable to its internal beauty. It was not built at the expense of the government, but by some private Vicentine gentleman of the Olympic Academy. The Academy was not confined to literary questions. Sometimes the programme included some classical tragedy. They used wooden theaters at first, and Palladio designed one for them in 1562. The Academy wished to found a permanent structure; therefore, Palladio was intrusted with the commission. The theater, begun in 1582, was completed in 1586, and was inaugurated by the performance of the "Œdipus Tyrannus" of Sophocles.

The general lines of the interior of the theater are noble and calm. The theater looks as well on paper as in reality; for, like so many of Palladio's buildings built of brick and stucco, which are now in a dilapidated condition, it has an enduring shabbiness. It must be said that in this remarkable building Palladio conciliated the precepts of Vitruvius and the needs of a contemporaneous society and it shows what a hold tradition had on the society of the late Renaissance, who were pleased by the resuscitation of dead forms. M. Eugène Müntz has expressed the conception of the theater when he said that it was a "mirage of a Paolo Veronese in architecture;" and, indeed, with its profusion of statues and niches and columns, it does resemble the works of the great painter of Verona, who, in his great light-filled frescoes and canvases, crowds the space with monumental architecture and fills the buildings with the well-dressed courtiers of Venice, until the whole becomes a gorgeous pageant.

The Current Supplement.

The current SUPPLEMENT, No. 1176, is almost entirely devoted to subjects of very present interest.

"The Spanish Battleship 'Pelayo'" describes the one great battleship of the Spanish navy, which is now returning from the Suez Canal to defend the coasts of Spain. The vessel is illustrated by a number of engravings showing the various guns, and even the telephonic installation on the vessel. "The Transport 'Alphonso XIII.'" illustrates a well known Spanish transport ship. "The Loss of the French Steamer 'Bourgogne'" refers to the recent lamentable accident, and illustrates this fine transatlantic steamer. "The Military Medical Services in Cuba" is the subject of a full paper. "The Causes of the Explosive Effect of Modern Small Caliber Bullets" is an important paper by Charles E. Woodruff, M.D., United States Army. This is a particularly important and timely paper, and is fully illustrated.

Other notable papers are "The Bolometer," by Dr. S. P. Langley, and, in "The Right to an Idea," Mr. A. R. Foote describes the subject with reference to the copyright and patent laws. "Historical and Mythological Trees" is a lecture by Dr. A. W. Miller, and is a curious and interesting paper.

AN aerial graphoscope is described in the Journal of the Society of Arts. A lath is rotated about its center in its own plane, and a picture projected upon it by a magic lantern. The apparatus illustrates persistence of vision, and may be used for testing it quantitatively. Three tables of numerical results are given. The inventor suggests that the apparatus may be used for stage effects such as the dagger in "Macbeth."

RECENTLY PATENTED INVENTIONS.

Bicycle Appliances.

BICYCLE-SUPPORT.—WILLIAM METZRATH, Highland Park, N. J. This bicycle-support comprises a clip adapted to be secured to the lower brace of the bicycle and has an open, lengthwise slot and rear shoulder. In the slot a head is pivoted which also has an open slot, but running transversely. A pin crosses the latter slot centrally. Two legs are pivoted at opposite sides below and equidistant from the cross-pin, and have notches in their extended upper ends for engaging the same. A spring and locking pin are provided, the pin being adapted to enter coincident holes in the clip and head.

DRESS-GUARD ATTACHMENT.—WILLIAM SHIRLEY, Coventry, England. The purpose of this invention is to provide an attachment by means of which a dress-guard may be quickly applied to a bicycle and by means of which the guard may be stretched and readily removed whenever necessary. The device consists of a keeper and a latch adapted for locking engagement with the keeper and having casings formed upon its body. The latch is provided with spring-controlled members having movement in the casings and arranged for attachment to the dress-guard.

BRAKE.—JULIUS L. ALLEN, Mendocino, Cal. The brake provided for by this invention is an improvement upon those brakes in which a loose band or sleeve revolves freely around a rigid drum or axle adjustable to apply the brake when necessary. To the fork of the bicycle, clamps composed of elastic bands are applied. Right-angular screw-bolts, whose inwardly projecting portions constitute fulcrum pins on which the brake arms are pivoted, are also provided. A looped spring having eyes for receiving these pins engages the forks and roller drums at its respective ends, and serves to support the roller of the brake out of contact with the tire.

Mechanical Inventions.

PAPER-TUBE MACHINE.—FREDERICK S. BARUS, Jersey City, N. J. The purpose of this invention is to provide a machine for making paper tubes such as those used in the manufacture of fireworks. The invention consists primarily of a rolling table, a recessed head on the table and a slidable mandrel-frame, carrying a revoluble mandrel adapted to engage the paper in the recessed head. A knife-frame is pivoted in the slidable frame and carries spaced knives for cutting the paper into strips, the mandrel afterward rolling the strips into tubes.

COIN-CONTROLLED VENDING MACHINE.—CHARLES E. SNAPP, Grottoes, Va. This invention provides for a machine which will automatically deliver cigars, packages of cigarettes, and similar articles when a trip mechanism is operated by a coin of a certain denomination, the device being so arranged that no coin or piece of metal other than the proper piece of money can operate the machine. The apparatus is provided with a coin-chute and compartment for holding cigars or other articles. A tiltable table is located below the compartment. A movable coin-carrier and lever mechanism are adapted to be acted on by the coin in passing through the chute so as to release one or more cigars.

PERCUSSION-DRILL.—JOSEPH P. HARTMAN, Pueblo, Col. This invention provides for a drill which can be operated by hand or power alike, but is especially designed for use by prospectors or miners working in districts where steam-apparatus cannot be transported. The drill comprises rotatable arms to which hammers are pivoted by their handles and made to come into contact successively with the head of a drill or a socket containing the drill. A circular hammer track controls the path of the hammers. Springs are connected to the hammers and hold them at all times against the track. Means for increasing the tension on the springs at certain predetermined points are also provided.

Miscellaneous Inventions.

VALVE-GEAR FOR PUMPS.—JOHN DOHERTY, Lockport, N. Y. The valve-gear provided by this inventor is especially adapted for use with single pumps. The gear comprises a pivoted lever or dog having its outer end pointed or diamond-shaped and forming inclined cam surfaces, connections therefrom to the steam-valve and a plunger having a roller bearing on the cam-surfaces of the dog and toward its pivot. A pivoted lever has vibratory connection with the pump-rod and has arms embracing the dog. Set-screws extend through the arms, whereby the slack or lost motion between the arms and dog may be regulated. This gear, it is claimed, will enable a pump to be run at as slow a speed as desired without any probability of the pump stopping.

SASH-FASTENER.—JOHN GREIFE, Dayton, Ky. This sash-fastener is so constructed as to be readily applied to a window without cutting the casement or sashes, and when in operation is adapted by manipulation of one part of the device to lock both sashes simultaneously. The sash-lock is provided with a rockable friction-block adapted to lock the lower sash. A pivoted bell-crank lever is located above the rockable friction-block. Another friction-block is located on a pusher-bar, which is rockable on a limb of the bell-crank, and is thus adapted for projection toward the upper sash to lock it. Means are also provided to connect the bell-crank and lower friction-block for their simultaneous rocking movement. A projection on the bell-crank supports the upper friction-block when it is rocked away from the upper window-sash.

GRAIN-REEL FOR REAPING MACHINES.—MARSHAL G. and PETER P. KEEN, Keensburg, Ill. The object of this invention is to provide a reel which shall take less space than ordinary reels, and which shall describe a complete circle in its movements. A simple arrangement is provided whereby the reel may be adjusted relatively to the cutters. The reel is so constructed that it may be folded down closely upon the platform for convenient storage and transportation. On the reaper-frame toggle-links are mounted to swing. Means are provided for swinging the links relatively to the platform and one relatively to the other. A tubular shaft is carried by the upper link. A reel-shaft extends through the tubular shaft. Means are provided for rotating the reel shaft. On this shaft sprocket-wheels are mounted which are engaged by sprocket-chains. For the sprocket-wheels guideways are provided comprising downwardly diverging side portions and a bottom portion suspended in the arc of a circle. To the chains reel-boards are attached.

BALL-BEARING.—JOHN R. SAUCIER, New Iberia, La. The object of this invention is to provide a ball-bearing more especially designed for use in the step for the vertical shaft of a heavy machine rotating at a high rate of speed, the arrangement being such as to dispense with the use of high-grade lubricants and at the same time permitting the shaft to run with great speed, without overheating the bearing. The bearing comprises a cup-shaped casing formed at its inside with a support on which an oil box is hung within the casing. A button is set in the bottom of the box and is formed on its top with a circular groove. The lower shaft rests on a second button above the first named button. The second button is provided in its under side with a circular groove registering with the groove in the other button. Balls fill the grooves to separate the buttons.

FOUNTAIN ATTACHMENT FOR PENHOLDERS.—CARL J. RENZ, New York city. The object of this invention is to provide an attachment adapted for application to any penholder, the attachment being a substitute for the clamp usually provided to hold a pen in the holder. When not in use the attachment may be reversed and the pen introduced entirely in the holder. The attachment comprises a body, a fingered tip at the forward end of the body, having transverse cells in its upper face, and a spring secured to the under side of the body and having its forward end curved upwardly and extending in close proximity to the under face of the tip to hold the attachment firmly in the holder.

DEVICE TO PREVENT COWS FROM KICKING.—CHRISTOPHER A. EIDSMOE, Pleasant, South Dakota. This device consists of a body constructed of two pivotally connected members, one member being provided with a lower and with an intermediate open clamping-band, both adapted to embrace the leg of the cow, so as to prevent flexure of the leg. These bands face in opposite directions. The other member is provided with an upper open clamping-band facing in the same direction as the lower clamping-band. Means are provided for locking the two members of the body in place.

CLOTHES-LINE BRUSH.—DARIUS F. GALLAGHER, New York city. The purpose of this invention is to provide a brush more especially designed for use on clothes-lines, so as to clean the line automatically when the latter is in motion. The brush has a spirally bent back and bristles extending from the inside of the back to engage the surface of the clothes-line, to clean it when pulling the line through the brush in an axial direction thereto.

GARBAGE APPARATUS.—IRA C. GOODRIDGE, Rochester, N. Y. With this apparatus, garbage can be readily passed from the kitchen to a suitable removable receptacle in a casing in or on the outside wall of the building, so as to facilitate the emptying of the contents of the receptacle into a cart. The apparatus comprises a receiver within a room of the building and is provided with a lid. A casing is located outside of the building and below the floor of the room in which the receiver is placed. This casing is provided with a door. A pipe leads from the receiver out through the wall of the building and then down into the casing. A plunger in the portion of the pipe leading through the side of the building enables the garbage to be forced into the receptacle.

HAT GUARD.—WILLIAM LORD, New York city. The prime object of this invention is to provide a guard which shall be entirely concealed when not required. The hat-guard has a plate secured by one end only to the sweat-band, so that the main portion of the plate will be free to permit a cord to be wrapped around it, the plate being provided at its other end with a transversely extending socket. A cord is secured to the end of the plate opposite that having the socket. A bar on the free end of the cord permits the latter when not in use to be wrapped around the plate and one end of the bar to be inserted in the socket.

COMBINED CHAIR AND BED.—BERNARD MURTAGH, Hewlett's, N. Y. This combined chair and bed has a base with front uprights and a back having a hinged connection with the base. Detachable arms are provided having rearwardly extending tongues for entering openings in the uprights. There is also a slot and key connection between the rear ends of the arms and the back. When the piece of furniture is to be used as a chair, the arms hold the back in a vertical position. When the article is to be used as a bed, the arms are removed and placed in the base chamber.

SAFETY DEVICE FOR ELEVATORS.—RAFFAELE PAROSELLI, Jersey City, N. J. The purpose of this invention is to provide a device which shall stop an elevator quickly in case of breakage of the cables. A mechanism is also provided whereby the car may be safely lowered to a landing should it stop between floors. The car or cage is formed in two parts adapted to have vertical movement. A locking device is normally adapted to restrain the movement of the parts in one direction. Clutch-dogs are provided which are adapted to engage the elevator guides by the relative movements of the parts of the cage. The suspension device of the car has a limited yielding action. A trip for the locking device is actuated by the recoil of the suspension device when the strain on the latter is relieved. The lowering device comprises a governor fixed at the top of the elevator well and has a wheel adapted to receive a flexible conductor passing over the wheel and adapted to be connected to the car to support it. Means are provided for freeing the car and for locking it in the well at will. By positive means the belt is prevented from slipping on the wheel.

MAGAZINE PISTOL.—WESLEY H. TRIPPET, Redlands, Cal. This firearm is provided with a magazine adapted to contain cartridges, the magazine being mounted to turn under the barrel. The rim of the magazine is inclined to the axis of the magazine and provided with bores whereby, when the magazine is turned, the bores are successively brought in alinement with the barrel of the weapon at the rear end. An external guard for the magazine holds the cartridges in place.

CONVERTIBLE VEHICLE AND ROCKER.—CHARLES W. WEDDELL and JAMES K. WATERS, Thurmont, Md. In this invention a novel device is provided whereby a child's wagon is adapted to be converted into a rocking chair. The front axle of the wagon is designed to be swung by the occupant of the vehicle. The vehicle body is provided with a removable bottom, below which another bottom is located having two spaced elongated apertures near its forward end. A wear-plate on the body is adapted to receive the threaded body of a screw-bolt. A wear-plate is also secured on the front axle in loose contact with the upper wear-plate and has a curved slot through which the screw-bolt passes. This slot has a length adapting the two wear-plates to be slidable one on the other and to limit the swinging movement of the front axle.

MOP.—HERRMAN A. WOLFF, New Haven, Conn. The purpose of this invention is to provide a mop which shall not scratch polished surfaces and which shall have its mopping material so arranged as to act like the bristles of a brush. The mop has a body-plate provided with a marginal flange and slots in its surface within the flange. Strips of absorbent material are passed downwardly through adjacent slots, crossing the webs between the slots. The end strips are carried upward over the ends and side portions of the flange of the body plate adjacent to the ends. A clamping plate having roughened ends is fitted to the slotted portion of the body-plate. Fastening devices secure the clamping plates and body together. A handle is fitted into a socket of the clamping plate.

PESSARY.—ANNA M. LONGSHORE-POTTS, London, England. With the neck of the cup of this pessary, having its end screw-threaded and provided with a bore square in cross-section, is connected a stem having a square head fitting in the bore of the neck and provided with a reduced extension beyond the head. A spring in the bore of the neck has one end secured to the extension of the stem. A screw-cap is fastened on the end of the neck and through it the stem loosely slides.

THATCH-ROOFING.—CHARLES N. BUSHNELL, Oquawka, Ill. The purpose of this invention is to provide a cheap form of thatch-roofing which is made complete and furnished in rolls and only requires to be laid on the rafters and then attached. The portable thatch-roofing consists of wisps of straw or like material fastened together by wires transversely to the length of the wisps. The body part of the wisps is arranged two-ply or with one wisp in one layer opposite the space between two wisps of the other layer. The butt ends of the wisps are arranged in overlapping shingle-like layers.

POST-OFFICE BOX CABINET.—JACOB C. KEITH, Ellwood City, Pa. This invention is an improvement in post-office-box cabinets, and seeks to provide a simple and novel construction by which the box doors may be opened from a keyboard under the control of an official or may be opened by a proper manipulation of the lock by the holder of the box, the purpose being to put the box under the control of the person who rents it and yet permit the box to be easily opened for such a person, should he not have the key of the lock or should he have forgotten the combination, if combination locks are used. The invention consists, in connection with a box-door, of means by which the holder of the box may release the bolt of the door, together with catches for engagement by the bolt, and a keyboard and means operated therefrom for freeing the catch and bolts from engagement.

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(7463) W. V. asks: 1. Can the same length of spark be obtained in the induction coil of SUPPLEMENT, No. 160, by using No. 30 or 31 single cotton covered wire instead of No. 36? If not, what length will they give? A. No. If wound equally close, the spark will be about one quarter as long with No. 30 as with No. 36 wire. 2. What size will the tinfoil in the condenser be? A. The size of the condenser is determined by the primary current and would not be changed whatever changes were made in the secondary winding. Cut the sheets of tinfoil to go into the box at base of coil. The proper surface of tinfoil is 40 square feet. 3. Do you have a SUPPLEMENT that tells you how to make a folding camera, size 4×5 or 5×7? What number is the SUPPLEMENT? A. For folding camera, see SUPPLEMENT, No. 1021. For mode of making bellows, see SUPPLEMENT, No. 625. Other articles may be found in SUPPLEMENTS, No. 806 and 1064, price 10 cents each by mail.

(7464) S. E. writes: Please send me a SUPPLEMENT containing an article on the prevention of creeping salts in a salammoniac battery. A. We do not know any separate article on the checking of creeping of salts in battery jars. It is done by the following method: Take paraffine wax, 2 parts; vaseline, 1 part. Melt together. Clean and dry the cells. Dip the neck of the cell about an inch into the melted solution. By dipping obliquely and rolling the jar around, it will be coated on the inside as well as on the outside. Over this surface the salts will not creep.

(7465) W. G. R. asks: Have you any book or books giving a full explanation of differential arc light system? A. A valuable series of papers on the arc light appeared in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1047-1052, also one on driving powers, equalizers, etc., in SUPPLEMENT, Nos. 694, 695, 696, price ten cents each by mail.

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JULY 5, 1898,

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(Continued on page 46)

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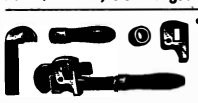

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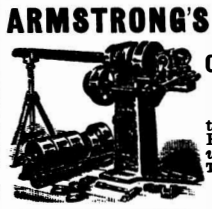

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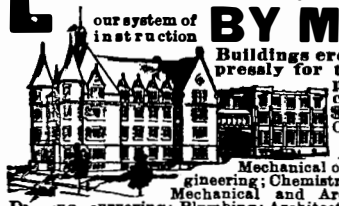

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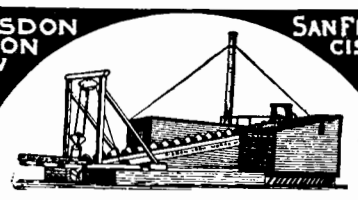

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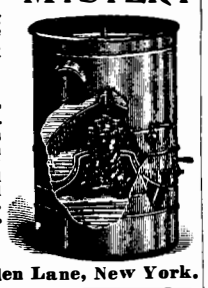

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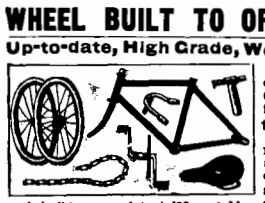

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C. Y. O'CONNOR, Engineer-in-Chief.
Public Works Office, Perth, Western Australia.
20th May, 1898.

GOVERNMENT OF WESTERN AUSTRALIA.—Coolgardie Water Supply.—Welded Steel Pipes. The Government of Western Australia is prepared to receive tenders for the supply and delivery in Western Australia of about 82 miles of Welded Steel Pipes of from 26 to 29 inches internal diameter. Form of tender with Drawings, Specification and Conditions of Contract annexed, may be obtained on payment of a fee of Two Guineas, in Europe at the Office of the Agent-General for Western Australia, 15 Victoria Street, Westminster, London, S. W.; in America, at the Office of Messrs. Seward, Guthrie & Steele, 40 Wall Street, New York; and in Western Australia, at the Office of the Honorable the Director of Public Works, Perth. Tenders, sealed and endorsed "Tender for Welded Steel Pipes," are to be delivered addressed, either to the Agent-General, at his Office aforesaid, or to the Honorable the Director of Public Works at Perth, Western Australia, on or before 12 noon, on Tuesday, the 23d day of August next. No tender will be considered unless on the prescribed form without being detached from the Specification and Conditions of Contract. The Government does not bind itself to accept the lowest or any tender. By order of the Hon. the Director of Public Works.
C. Y. O'CONNOR, Engineer-in-Chief.
Public Works Office, Perth, Western Australia.
20th May, 1898.

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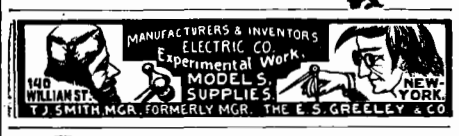

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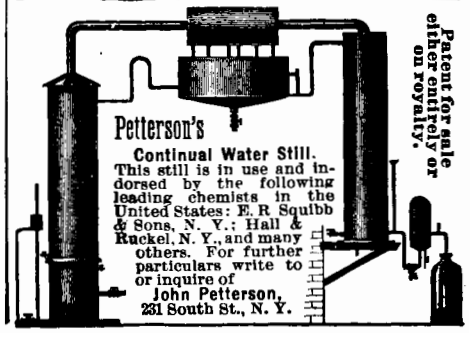

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